

THE COMMONWEALTH OF MASSACHUSETTS  
STATE RECLAMATION & MOSQUITO CONTROL BOARD

# CENTRAL MASSACHUSETTS MOSQUITO CONTROL PROJECT

111 Otis Street, Northborough, MA 01532-2414  
Telephone (508) 393-3055 • Fax (508) 393-8492  
[www.cmmcp.org](http://www.cmmcp.org)



## ANNUAL REPORT 2005

## PREFACE

The 2005 Annual Report of the Central Massachusetts Mosquito Control Project (the Project) has been prepared to provide the citizens and officials of the member cities and towns with information pertaining to the Project's control procedures and related activities.

As you read through this report you will notice that the Project is committed to an Integrated Mosquito Management (IMM) program. IMM utilizes a variety of control techniques and evaluation procedures. All control efforts are undertaken only after surveillance data has been collected and analyzed. This allows control decisions to be made based on the exact need that exists at each specific site. Environmental considerations are paramount when prescribing various control techniques.

The CMMCP Board of Commission is appointed by the State Reclamation and Mosquito Control Board to represent your community's interest. The Commissioners meet with the Executive Director and Director of Operations on a regular basis to discuss and formulate policies, and to provide their expertise in the operation of the Project. The Commissioners welcome your input, and we encourage you to schedule an appointment to visit our Project headquarters.

Copies of this report are distributed to key officials and departments in our member communities, as well as to the public libraries. We would encourage officials to take time from their busy schedule to read this report. Project personnel are available to answer questions you may have, and to meet with you to discuss out procedures and techniques. The Project's website at [www.cmmcp.org](http://www.cmmcp.org) has extensive information on mosquito control in Central Massachusetts.

The Project's goal is to provide effective and environmentally sound mosquito control, reducing mosquito annoyance and the potential for the transmission of mosquito-borne diseases. Our staff of competent, well-trained employees are known throughout the member communities as individuals who take great pride in their work.

Thank you,

Richard J. Day, Chair  
Board of Commissioners  
Central Massachusetts Mosquito Control Project

**THE COMMONWEALTH OF MASSACHUSETTS**

State Reclamation & Mosquito Control Board  
251 Causeway Street Suite 500  
Boston, Massachusetts 02114

<http://www.mass.gov/agr/mosquito/>

**State Reclamation Board - Members**

Mr. Mark Buffone (DAR) - Chair

Mr. Charles Burnham (DCR)

Mr. Gary Gonyea (DEP)

Ms. Donna Mitchell - Projects Administrator

**Commissioners of Central Massachusetts Mosquito Control Project**

[commission@cmmcp.org](mailto:commission@cmmcp.org)

Mr. Richard J. Day - Chair  
Chelmsford, Massachusetts

Mr. Dean Mazzarella  
Leominster, Massachusetts

Mr. Pablo E. Noguera  
Londonderry, New Hampshire

Mr. George Smith  
Northborough, Massachusetts

Mr. Paul Mazzuchelli  
Milford, Massachusetts

**Staff of Central Massachusetts Mosquito Control Project**

**Executive Director**

Mr. Timothy D. Deschamps  
[deschamps@cmmcp.org](mailto:deschamps@cmmcp.org)

**Director of Operations**

Mr. Timothy E. McGlinchy  
[mcglinchy@cmmcp.org](mailto:mcglinchy@cmmcp.org)

**Staff Entomologist**

Mr. Curtis R. Best  
[best@cmmcp.org](mailto:best@cmmcp.org)

**Wetlands Project Coordinator**

Ms. Amanda Hope  
[hope@cmmcp.org](mailto:hope@cmmcp.org)

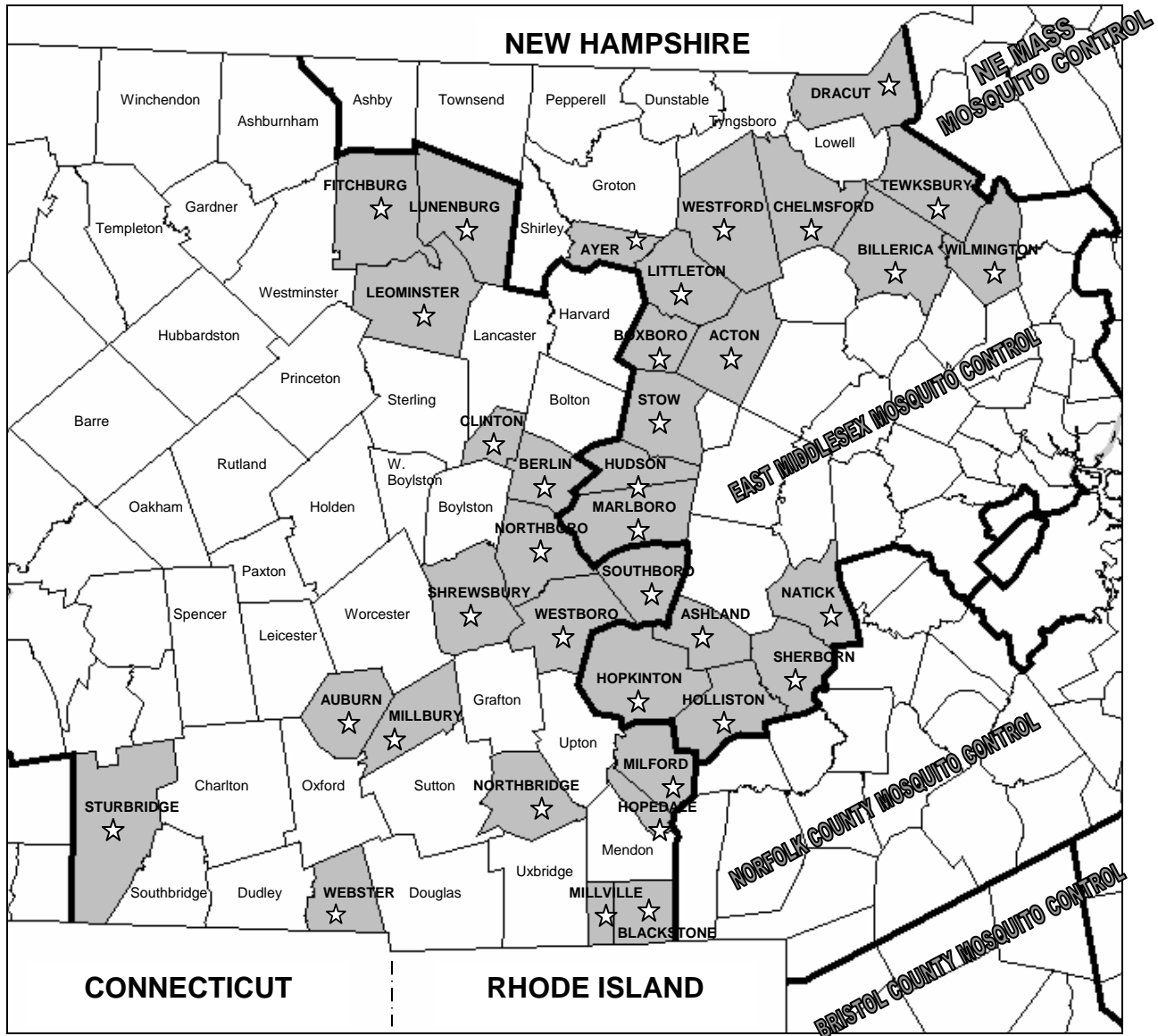
**Office Manager**

Ms. Karen Millet  
[millet@cmmcp.org](mailto:millet@cmmcp.org)


LIST OF MEMBER COMMUNITIES

| <u>TOWN</u>           | <u>SQUARE MILES</u> |
|-----------------------|---------------------|
| <b>DISTRICT ONE</b>   |                     |
| BILLERICA             | 25.96               |
| CHELMSFORD            | 22.70               |
| DRACUT                | 20.90               |
| LITTLETON             | 16.60               |
| TEWKSBURY             | 20.70               |
| WESTFORD              | 30.60               |
| WILMINGTON            | 17.12               |
| <b>DISTRICT TWO</b>   |                     |
| ACTON                 | 20.00               |
| AYER                  | 9.00                |
| BOXBOROUGH            | 10.40               |
| FITCHBURG             | 27.80               |
| LEOMINSTER            | 28.90               |
| LUNENBURG             | 26.40               |
| STOW                  | 17.60               |
| <b>DISTRICT THREE</b> |                     |
| BERLIN                | 12.90               |
| CLINTON               | 5.70                |
| HUDSON                | 11.50               |
| MARLBOROUGH           | 21.10               |
| NORTHBOROUGH          | 18.50               |
| SHREWSBURY            | 20.70               |
| SOUTHBOROUGH          | 14.10               |
| <b>DISTRICT FOUR</b>  |                     |
| ASHLAND               | 12.40               |
| HOLLISTON             | 18.70               |
| HOPEDALE              | 5.27                |
| HOPKINTON             | 26.60               |
| MILFORD               | 14.60               |
| NATICK                | 15.10               |
| SHERBORN              | 16.00               |
| WESTBOROUGH           | 20.50               |
| <b>DISTRICT FIVE</b>  |                     |
| AUBURN                | 15.40               |
| BLACKSTONE            | 10.90               |
| MILLBURY              | 15.70               |
| MILLVILLE             | 4.92                |
| NORTHBRIDGE           | 17.20               |
| STURBRIDGE            | 37.40               |
| WEBSTER               | 12.50               |
| Total Square Miles    | 642.37              |

# CMMCP SERVICE AREA



≈ 2005 ≈

 = member towns



## MOSQUITO CONTROL ACTIVITIES

One basic fact of the mosquito's biology is the dependence on still, stagnant water to complete its life cycle from egg to adult. Currently, there are two basic control methods practiced by the Project to disrupt this process. The first and most permanent method is called "*water management, source reduction or wetlands restoration*". This method reduces or eliminates the source of a potential mosquito problem, and consists of cleaning road-side ditches and culverts, removal of brush and accumulated debris from streams, and removal of containers which contain water. All of the above mentioned methods serve to accomplish the same goal - they permit water to flow freely, and reduce the likelihood for stagnant areas, areas in which the mosquito needs to reproduce. Source reduction is practiced year-round, and is done only after extensive examinations, and permission is received by the property owner(s).

There are places where water management is neither practical nor feasible for one reason or another. In these situations, we practice a method called *larviciding*. After a field technician has determined that larval mosquitoes are present, a small amount of environmentally sensitive product is applied to the area according to label directions. This is often a very effective control method, reducing the emergence of the adult mosquito from that area. Larviciding is practiced from late-March to September. Bti is the product of choice for larviciding in wetlands.

A third method is to attempt to control the adult mosquito. The control of adult mosquitoes is done on a *request-only* basis, and the presence of adult mosquitoes is confirmed before any application is done. Adulticiding can be an effective method of *temporary* control, which can be beneficial prior to public gatherings, outdoor events and festivals, or when mosquito populations have been determined to be intolerable. Since this part of the program is done **only upon request**, this allows the individual resident to have the ultimate discretion on mosquito spraying in their area - how much or how little. Exemptions for spraying are handled through the City/Town Clerk and the Project office, and are updated each year. Adulticiding is done from approximately Memorial Day to Labor Day, depending on prevalent mosquito populations and the mosquito-borne disease situation.

All products used by the Project have been extensively tested by manufacturers, the US government and mosquito control agencies for many years. They are registered by the EPA and the Mass. Pesticide Bureau. Labels and fact sheets are available upon request to the public from the Project's office, or from our website.

We operate a full surveillance program in our service area. The landing rates performed by our field staff are brought back to the Project lab to be keyed out to species, allowing us to tailor our larviciding program and reduce future dependence on adulticides. We have a mobile team of specialized mosquito traps, called *gravid traps*, designed to capture virus-bearing mosquitoes. These mosquito collections, called *pools*, are sent into the Mass. Dept. of Public Health (MDPH) laboratory in Jamaica Plain for testing of West Nile Virus, Eastern Equine Encephalitis, and other arboviruses of concern by MDPH. These traps are used in a rotation throughout our service area, and are then concentrated in areas showing arboviral activity to supplement MDPH's collection protocols. Additional trap types are utilized in suspect areas to monitor and evaluate the risk of viral transmission to the local populace.

A comprehensive educational program is offered to area schools and civic groups. The program is aimed towards mosquito biology, mosquito habitat, and efforts citizens can undertake to reduce the potential for mosquito populations in their own neighborhood. This program is tailored to suit the requirements of the individual group, from elementary school children, to high school, to adult groups.

## PROGRAM EVALUATION

This is a part of the program which many people involved directly never see. It must begin with a carefully planned program, one designed so that the data obtained during surveys before treatment and the surveys taken after treatment can be analyzed by statistically sound methods. Only by doing this can the value of a mosquito control program be determined. We will then know what type (species) of mosquito we are dealing with; what the population density is; what method(s) of control provide the most economical and efficient results.

Then and only then can we say that we have or have not affected mosquito control on a level that is acceptable to the community.

#### SEASONAL OUTLINE OF MOSQUITO CONTROL PROGRAM

1. Vehicle and equipment repair and storage - November through March
2. Wetlands Restoration - throughout the year
3. Program Preparation - December through March
4. Map compilation and training - throughout the year
5. Larviciding - May through September
6. Adulticiding - June through September
7. Catch Basin Treatment - May through September

Any mosquito control being done by individual member communities must, by law, be coordinated through the Central Massachusetts Mosquito Control Project.

## SERVICES AND ACTIVITIES

The following services and activities are available to those communities participating in the Central Massachusetts Mosquito Control Project:

### **ADMINISTRATIVE**

1. Assess the need for mosquito control within each of the member communities.
2. Plan and organize a mosquito control program for each member community based on the specific needs of that community.
3. Assist member communities to implement mosquito control programs so as to enable the residents of that community to receive maximum benefits from organized mosquito control.
4. Administer new and coordinate existing mosquito control programs.
5. Collect and maintain accurate records of mosquito populations, ascertain prevalent species, and collate pertinent data for each member community.
6. Cooperate with federal, state and local agencies concerned with vector control programs which may be implemented in the community.
7. Prepare annual reports of Project activities, mosquito population density profiles, recommendations, and any other data requested by the member communities.
8. Provide supervision to staff members and encourage policies which lend themselves to effective and efficient mosquito control.

### **PUBLIC EDUCATION**

1. Inform the general public, as well as professional groups, of the mosquito control activities intended for each member community through news releases, speakers for community and professional organizations, special educational and training programs (including seminars for environmental interest groups), integration of proposed vector control programs with other organizations, agencies and institutions with similar goals.
2. Offer educational programs to the public school system within the member cities and towns. Programs will be aimed toward mosquito biology, mosquito habitat, and efforts which citizens can undertake to reduce mosquito populations in their neighborhoods.
3. Keep the member communities informed of changes and advancements in mosquito control technology and legislation.

## MEDICAL ENTOMOLOGY LABORATORY REPORT 2005

The mission of the Medical Entomology Laboratory is to refine and maximize the CMMCP's ongoing effort to control mosquitoes. During 2005 CMMCP personnel carried forward this mission in the following ways:

- Medical Entomology Laboratory personnel made educational presentations about mosquito biology and mosquito control practices before elementary school students;
- CMMCP's larviciding and adulticiding practices were evaluated for efficacy;
- Mosquito species native to the CMMCP district were tested for resistance to an insecticide used to control adult mosquitoes;
- An evaluation comparing ground based traps to elevated traps in the tree canopy to maximize adult mosquito collections.

Our physical capabilities were improved during 2005 by the acquisition of seventeen (17) New Standard Miniature Light Traps with Photocell-controlled CO<sub>2</sub> Release and two (2) Collection Bottle Rotators. These miniature light traps use a small incandescent light bulb to attract mosquitoes. Cleaner collections may be made by not using the light bulb, and instead use CO<sub>2</sub> gas released from a cylinder as the attractant. The addition of CO<sub>2</sub> gas also results in larger collections of mosquitoes. This trap has a small precision pneumatic valve which is controlled by an internal photoswitch that times the release of the CO<sub>2</sub> with the ambient light level. Therefore the release of gas is only taking place when mosquitoes are most likely to be active in the area being monitored.

The Collection Bottle Rotator is a device which allows segregating the catch of a light trap into 8 bottles over periods of time determined by a programmable timer. These will provide information about the periodicity of mosquito activity which in turn will help target more precisely our mosquito control activities.

During 2005 four (4) interns were employed for part of the season to operate the mosquito surveillance traps and perform efficacy or resistance studies. Using their knowledge of mosquito behavior and the local terrain, these skilled and experienced personnel monitored the adult mosquito populations in our service area. Crews were rotated through the member cities and towns on a (minimum) bi-weekly basis, and were dispatched to area "hot zones" when avian and/or mosquito data showed the presence of mosquito-borne diseases. The New Standard Miniature Light traps with the timed release of CO<sub>2</sub> were used to monitor the adult mosquito population for Eastern Equine Encephalitis (EEE). The CO<sub>2</sub> used as the attractant sample for mammal-biting species. Modified Reiter Gravid Traps were used to monitor the adult populations for West Nile Virus (WNV). These traps are attractive to the mosquito species data has shown to be most likely to have a role in the maintenance cycle and transmission of WNV in our area and across the US.

Laboratory personnel made more than 1,254 collections this season. These collections contained more than 90,000 adult mosquitoes. These collections were identified to species and sorted to identify the species known to play a role in arbovirus transmission in our area. Collections were sent to the Mass. Department of Public Health (MDPH) State Laboratory in Jamaica Plain each week to be tested for EEE, WNV and other diseases. CMMCP staff logged in these collections through a new system implemented by MDPH this year. This system is a web-based, bar code system which allows for faster tracking and testing. The web-based system allowed CMMCP administrative staff to log in for results and not wait for phone or internet notifications. Eight (8) CMMCP collections were confirmed positive for mosquito-borne diseases (see table 1). Our surveillance confirms that these pathogens were circulating in the local environment in

2005. Intervention measures were performed in collaboration with the local Boards of Health.

**TABLE 1**

| Pool ID    | Town        | Tested Date | Species                  | Result       |
|------------|-------------|-------------|--------------------------|--------------|
| CM05-00672 | Westborough | 8/23/2005   | <i>Culex species</i>     | WNV Positive |
| CM05-00737 | Westborough | 8/29/2005   | <i>Culex salinarius</i>  | WNV Positive |
| CM05-00769 | Westborough | 8/29/2005   | <i>Culiseta melanura</i> | EEE Positive |
| CM05-01096 | Westborough | 9/28/2005   | <i>Culiseta melanura</i> | WNV Positive |
| CM05-01097 | Westborough | 9/28/2005   | <i>Culex species</i>     | WNV Positive |
| CM05-01144 | Holliston   | 10/4/2005   | <i>Culex species</i>     | WNV Positive |
| CM05-01157 | Wilmington  | 10/4/2005   | <i>Culex species</i>     | WNV Positive |
| CM05-01170 | Westborough | 10/4/2005   | <i>Culiseta melanura</i> | EEE Positive |

The Medical Entomology Laboratory at CMMCP is committed to the advancement of mosquito control practices by the application of the scientific method. Such a commitment will further enable us to provide our member communities with quality mosquito control for comfort and health.

|   |       |
|---|-------|
| <b>WNV Surveillance Summary - <u>Statewide</u></b>                        |       |
| Dead Birds Reported   | 2,493 |
| Birds Submitted for Testing   | 322   |
| Birds Tested  | 303   |
| Birds Positive  | 83    |
| Mosquito Pools Positive   | 99    |
| Horses Positive   | 0     |
| Humans Positive   | 6     |
| <b>EEE Surveillance Summary - <u>Statewide</u></b>                        |       |
| Mosquito Pools Positive   | 45    |
| Horses Positive   | 4     |
| Humans Positive   | 4     |
| ** An emu from Athol in Worcester County tested positive for EEE in 2005. |       |
| <b>CMMCP Surveillance Summary</b>   |       |
| Mosquito Pools Submitted for testing                                      | 1,192 |
| Mosquito Pools (total)  | 3,607 |
| Mosquito Pools Positive WNV   | 6     |
| Horses Positive   | 0     |
| Humans Positive   | 0     |
| Pools Positive EEE  | 2     |
| Horses Positive   | 0     |
| Humans Positive   | 0     |

## **CMMCP RESEARCH AND EFFICACY**

---

In 2005 we dedicated a limited amount of resources for efficacy and research. One summer intern was hired to perform efficacy and resistance studies, one intern collected data for his senior thesis at college, and other full time employees performed limited research according to their busy schedules and on their own time. The results of this research are outlined in the next few pages, and are summarized below.

- ◆ Pesticide Resistance in Adult Mosquitoes – a Bottle Assay
- ◆ Satisfaction Survey of Service Requests in 2005
- ◆ 2005 Larval Control program – Product Efficacy Evaluation
- ◆ A Preliminary Study of Ovitrap in Central Mass.
- ◆ Tree Canopy Preference of *Culex* and *Culiseta* Mosquitoes

CMMCP is committed to be on the forefront of mosquito control and strives to offer the latest advances in our industry. If you have any questions please call (508) 393-3055 or e-mail us at [cmmcp@cmmcp.org](mailto:cmmcp@cmmcp.org). Additional information on these studies is available on our website at <http://www.cmmcp.org/research.htm>

Thank you

*Timothy D. Deschamps*

Executive Director

# **RESISTANCE TO SCOURGE® INSECTICIDE IN THE MOSQUITO POPULATIONS OF FOUR TOWNS IN THE CENTRAL MASS. MOSQUITO CONTROL PROJECT SERVICE AREA: WESTBOROUGH, BILLERICA, TEWKSBURY, AND WILMINGTON**

ANN G. PARSLEY, Research Technician & TIMOTHY D. DESCHAMPS, Executive Director  
Central Mass. Mosquito Control Project  
111 Otis Street Northborough, Massachusetts 01532

## **ABSTRACT**

The Central Massachusetts Mosquito Control Project (CMMCP) has been using a synthetic pyrethroid called resmethrin, trade name Scourge®, since the early 1990's to control adult mosquito populations in its service area. The current CMMCP policy is to accept service requests from residents and town officials for adult mosquito control and to perform limited, targeted applications, and not perform random, area-wide spraying as was the standard procedure for adult mosquito control in Massachusetts decades ago. As part of our Standard Operating Procedures manual and as a function of an Integrated Mosquito Management (IMM) plan, surveillance is analyzed before any product is applied to justify the application. This can be in the form of landing rate counts or data collected from mosquito traps. Resistance to a class of chemicals has been noted in other areas of the world, and we will attempt to determine if any mosquito species or any collections of mosquitoes from a given area will show resistance to the synthetic pyrethroid class of chemicals. If resistance is noted, this may affect the product choice for vector-borne disease control, as well as the reduction of nuisance levels of mosquitoes. Initial results from 2005 show a minor potential for resistance, but no change in product usage is recommended at this time. There is no indication that resistance levels will increase due to the limited, sporadic nature of the CMMCP adulticide program, but further study would be prudent.

## **INTRODUCTION**

The purpose of this study was to determine whether or not resistance to resmethrin was developing in the mosquito populations at the most frequently sprayed properties. If significant resistance were present, it could necessitate changing from resmethrin to a different product registered in Massachusetts and accepted by the Centers for Disease Control (CDC) for mosquito control. This would be particularly important in the case of an outbreak of mosquito-borne diseases such as West Nile Virus (WNV) or Eastern Equine Encephalitis (EEE). If a particular species of mosquito or a mosquito collection from a given area has been shown to be resistant to the pyrethroid class of chemicals, then vector suppression may need to be done using different products and procedures. The towns of Westborough, Billerica, Tewksbury and Wilmington were chosen for the study because these are the only towns in the CMMCP service area where WNV or EEE have been found either in mosquitoes, horses or humans. WNV was found in a collection of mosquitoes in Westborough in 2003, and that same year a woman in the area of the virus positive mosquito also contracted WNV. Horses in Billerica and Wilmington were identified to have been infected with EEE in 2004, and mosquitoes positive for EEE were found in Tewksbury in 2002.

## **METHODS AND MATERIALS**

Five study sites were chosen in each town, from among the most frequently sprayed properties in the town according to the CMMCP database of service requests. The frequency of spraying was determined from a database of spray requests from 1998 to the present. Because the towns vary in their overall mosquito population and the number of requests is determined by the property owners, no two sites had exactly the same number of requests in each season. The number of spray requests varied considerably. The most frequently sprayed property had been sprayed 38 times over the eight year period, while the least frequently sprayed property had only been sprayed four times, all in 2004. Most of the properties had been sprayed between 12 and 25 times since 1998. All but two of the properties were at private homes; one was a public recreational area, and another was a wetland area at the end of a cul-de-sac.

The cul-de-sac site was chosen because at that site mosquitoes had been found to be positive for West Nile in 2003 and this was in the neighborhood of the human WNV case in 2003.

A control site was chosen in the town of Westborough in a swamp bordering an organic farm. This site has never been sprayed for mosquitoes by CMMCP, and to the best of our knowledge the town and the property owners did not apply any insecticides in that area. It was presumed that mosquitoes from this site would have no resistance to resmethrin having never been exposed to any insecticides.

At each site, live adult mosquitoes were collected using two CDC-style traps (John W. Hock Company) baited with carbon dioxide at 20 psi. The traps were set early in the morning and collected the following morning. Traps were set for one or two nights, depending on how many mosquitoes were collected. The number of mosquitoes tested for each site varied from 30 to 152; for most sites it was approximately 50.

The resistance testing was conducted according to the bottle bioassay procedure described by Brogdon and McAllister<sup>1</sup>. Scourge® insecticide (18% Resmethrin + 54% piperonyl butoxide synergist, lot no. 465-0815) manufactured by Bayer Environmental Science Company was diluted in acetone to make a 0.005% solution, and was evenly applied to coat the insides of 250ml Wheaton bottles (Fisher Scientific Company). Each bottle was coated with 1ml of acetone and 1ml of Scourge solution, containing 9.05 µg of resmethrin and 27.02 µg of piperonyl butoxide. This dosage was determined by testing seven batches of mosquitoes from the control site with Scourge/acetone solutions of different strengths. Controls consisted of bottles coated only with acetone.

After the mosquitoes were aspirated from the trap cage and introduced into the coated bottles, each bottle was checked at five-minute intervals, and the number of mosquitoes knocked down was recorded. A mosquito was considered knocked down if it could not regain a standing position when knocked off its feet by gently tapping or shaking the bottle. Knock-down was chosen as the standard rather than overall mortality because resmethrin may cause the mosquitoes to twitch even after they are dead, making the time of death difficult to determine exactly.

## **RESULTS**

No mosquitoes were knocked down in the acetone-only control bottles. The mosquitoes from the unsprayed control site were all knocked down within ten minutes, with 96% knocked down after only five minutes.

The mosquitoes from the recreational area site survived the longest, reaching 100% knocked down only at 35 minutes. At one other site, 100% were knocked down at 25 minutes. At twelve sites, 100% were knocked down at 20 minutes, and at six sites, 100% were knocked down at 15 minutes. Sample graphs are included in this presentation, and all data is available on the CMMCP website at <http://www.cmmcp.org/2005resistance.htm>.

## **DISCUSSION AND CONCLUSIONS**

At all of the study sites, the mosquitoes survived longer than those from the control site. The majority of the samples contained some individual mosquitoes that survived at least twice as long as the control mosquitoes. This would seem to indicate that some resistance to resmethrin may be developing in the populations surveyed.

However, another bottle bioassay study of resistance to various insecticides, including resmethrin, found resistant mosquitoes surviving for up to three hours.<sup>2</sup> In comparison, mosquitoes that survive for 20 to 35 minutes do not seem to be very resistant to resmethrin. If resistance is developing in the CMMCP service area, it appears to be at an early stage. A change of insecticide is not recommended at this time, although continued monitoring of resistance would be a wise course of action. Greater resistance could develop at a later date.

## REFERENCES

1. Brogdon WG and McAllister JC. Simplification of adult mosquito bioassays through use of time-mortality determinations in glass bottles. *J Am Mosq Control Assoc* 14:159-164 (1998).
2. McAbee RD, Kang KD, Stanich MA, et al. Pyrethroid tolerance in *Culex pipiens pipiens* var *molestus* from Marin County, California. *Pest Manag Sci* 60:359-368 (2003).



# SATISFACTION SURVEY OF SERVICE REQUESTS IN THE CENTRAL MASSACHUSETTS MOSQUITO CONTROL PROJECT SERVICE AREA – 2005

TIMOTHY D. DESCHAMPS, Executive Director  
 Central Mass. Mosquito Control Project  
 111 Otis Street Northborough, Massachusetts 01532

## ABSTRACT

Residents of our service area request service from the menu of services offered to them by CMMCP. Requests for adulticiding (spraying) and larval control are the most common forms of service requests we receive. We accept requests for service through a variety of means, primarily by telephone, but increasing more by the online service request form from the CMMCP website. Additional methods include personal visits to our office, phone calls on behalf of residents from town and/or state officials, and direct requests to our field staff. The CMMCP Commission authorized a survey of residents who requested service in 2005 to determine if our staff was meeting acceptable levels of customer satisfaction. After compiling these results, we find that a majority of residents in our service area were satisfied with our control efforts and methods.

## SURVEY METHODOLOGY

In 2005 we received 7,086 requests for service, ranging from adulticiding to larval control. 5,712 adulticiding calls were filtered and placed into a separate database. Service calls were sorted according to town, and each town was tabulated for total requests received in 2005. These towns were then graphed to show which towns had the most calls down to the towns with the fewest. Each town was assigned a percentage according to this data. This percentage would determine the number of postcards sent to each town from the overall total. The CMMCP Commission decided that 1,000 postcards would be a representative sample of the 5,712 service calls. The survey was designed to be as easy as possible for residents to access and complete. An online survey was created, and the postcards would include unique identifiers that the residents would use. The postcards contained a blind weblink to the survey so that unauthorized users would not be able to participate in the survey. Information such as how they contacted us, were the office and field staff helpful and informative, how long did they wait for service, was the service provided effective, and their overall satisfaction was measured.

## SURVEY FINDINGS

From 1,000 postcards mailed, 244 responses were received (24.4%). The results are as follows:

**1). In your most recent experience, how did you contact the Central Mass. Mosquito Control Project?**

|                  | Number | Percent |
|------------------|--------|---------|
| <b>Telephone</b> | 191    | 81%     |
| <b>Website</b>   | 38     | 16%     |
| <b>In person</b> | 3      | 1%      |
| <b>Other*</b>    | 5      | 2%      |
| <b>Total</b>     | 237    | 100%    |

\*4 through town offices, 1 through a neighbor

|              | Number | Percent |
|--------------|--------|---------|
| <b>Yes</b>   | 192    | 99.5%   |
| <b>No</b>    | 1      | 0.5%    |
| <b>Total</b> | 193    | 100%    |

**2). If by telephone or in person at the CMMCP office, were your questions or concerns answered to your satisfaction?**

3). If by telephone, did you experience difficulty reaching our staff?

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 19     | 9.9%    |
| No    | 172    | 90.1%   |
| Total | 191    | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 51     | 98.1%   |
| No    | 1      | 1.9%    |
| Total | 52     | 100%    |

4). If through the website or e-mail, did you find the information you needed in a satisfactory manner?

5). Please give the approximate time you waited for service from your initial request:

NOTE: 87.3% within a week or less

|          | Number | Percent |
|----------|--------|---------|
| 1-3 days | 74     | 31.4%   |
| 3-5 days | 60     | 25.4%   |
| 1 week   | 72     | 30.5%   |
| 2 weeks+ | 30     | 12.7%   |
| Total    | 236    | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 223    | 95.5%   |
| No    | 13     | 5.5%    |
| Total | 236    | 100%    |

6). Did you find our response from your initial request to when you received service within a reasonable amount of time?

7). Were your questions and concerns answered by the Technician to your satisfaction?

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 204    | 95.8%   |
| No    | 9      | 4.2%    |
| Total | 213    | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 138    | 40%     |
| No    | 192    | 60%     |
| Total | 330    | 100%    |

8). Did you receive any written information (pamphlets, etc.) from our representative?

9). Did you find this information useful?

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 80     | 95%     |
| No    | 4      | 5%      |
| Total | 84     | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 91     | 38.2%   |
| No    | 147    | 61.8%   |
| Total | 238    | 100%    |

10). Did you request service more than once in 2005?

11). If you requested additional service in 2005, was it because the original application was insufficient to meet your needs, or for a later re-treatment or follow up?

|              | Number | Percent |
|--------------|--------|---------|
| Re-treatment | 87     | 79.8%   |
| Insufficient | 22     | 20.2%   |
| Total        | 109    | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 230    | 98.3%   |
| No    | 4      | 1.7%    |
| Total | 234    | 100%    |

12). Would you/did you recommend our service to others in the future?

13). In your opinion, did our application made your area better, worse, or had no effect?

|           | Number | Percent |
|-----------|--------|---------|
| Better    | 205    | 87.6%   |
| Worse     | 0      | 0%      |
| No Effect | 29     | 12.4%   |
| Total     | 234    | 100%    |

|          | Number | Percent |
|----------|--------|---------|
| 1-2 days | 30     | 15.3%   |
| 3-5 days | 34     | 17.4%   |
| 1 week   | 40     | 20.4%   |
| 2 weeks+ | 92     | 46.9%   |
| Total    | 196    | 100%    |

14). If you think your area improved, can you give an approximate length of time you experienced relief from mosquito annoyance?

NOTE: 2/3 of residents polled reported relief of 1 week or greater, nearly 1/2 report more than 2 weeks of relief

15). On average, our services cost \$2.00 – \$4.00 per person each year (withheld from local aid rec'd from the State). In your opinion, is this amount too high, too low, or sufficient?

|            | Number | Percent |
|------------|--------|---------|
| Sufficient | 189    | 80.4%   |
| Too Low    | 41     | 17.5%   |
| Too High   | 5      | 2.1%    |
| Total      | 235    | 100%    |

|        | Number | Percent |
|--------|--------|---------|
| 1+     | 55     | 24.3%   |
| August | 24     | 10.6%   |
| July   | 67     | 29.7%   |
| June   | 80     | 35.4%   |
| Total  | 226    | 100%    |

16). In which month or months do you recall receiving service?

17). Overall, are you happy with the service provided this year by CMMCP?

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 211    | 90.9%   |
| No    | 21     | 9.1%    |
| Total | 232    | 100%    |

|       | Number | Percent |
|-------|--------|---------|
| Yes   | 228    | 98.3%   |
| No    | 4      | 1.7%    |
| Total | 232    | 100%    |

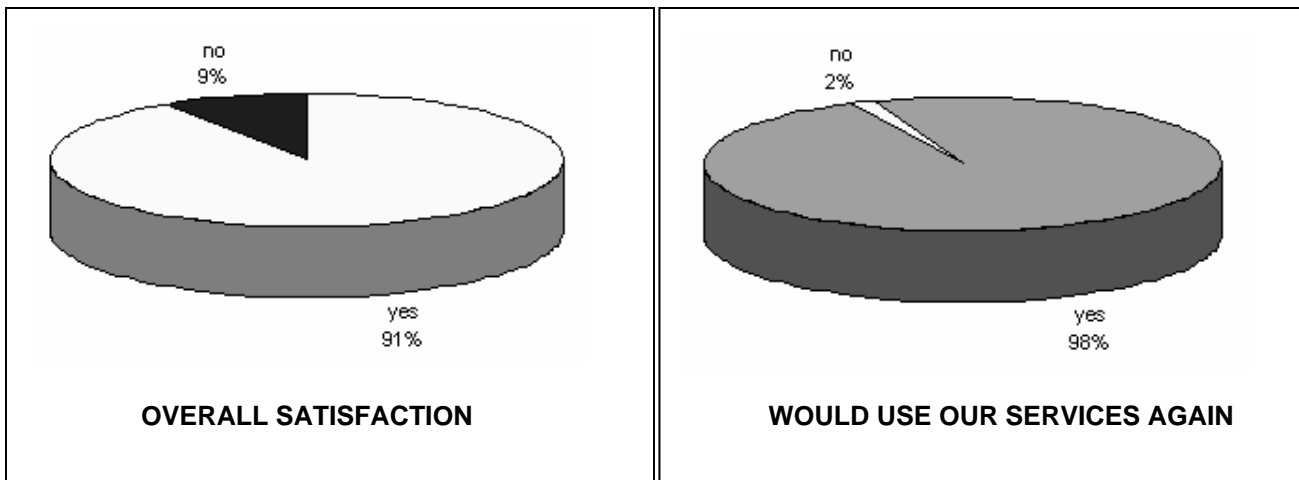
18). Do you plan on using our service again in the future?

Please rate our performance for 2005 from 0 to 5, where 5 is the best rating, 0 is the worst rating:

| QUESTION  | POINTS                  | AVERAGE            |
|---|-------------------------|--------------------|
| The information you received over the phone was informative & helpful               | 851 points from 1,010   | 4.2 average from 5 |
| The information on our website is easily available and helpful                      | 604 points from 745     | 4.0 average from 5 |
| The response time for service is reasonable   | 992 points out of 1,145 | 4.3 average from 5 |
| Our field staff that responded is knowledgeable and competent                       | 939 points out of 1,070 | 4.3 average from 5 |
| The service provided was effective  | 888 points out of 1,135 | 3.9 average from 5 |
| This service is reasonable compared to the cost                                     | 995 points out of 1,120 | 4.4 average from 5 |
| Please rate your overall satisfaction with the service received in 2005             | 975 points out of 1,140 | 4.2 average from 5 |
| <b>Total satisfaction rating: 6,244 points out of 7,365 possible – 4.23 average</b> |                         |                    |

### CONCLUSION

Overall satisfaction was 90.9% to 9.1%, and 98% would use our services again in the future. One weakness identified in this study is that only 40% of the residents polled recalled receiving our written information. The importance of public education and outreach will be stressed to all CMMCP personnel in 2006.



## 2005 CMMCP LARVAL CONTROL PROGRAM PRODUCT EFFICACY EVALUATION

TIMOTHY D DESCHAMPS, Executive Director & TIMOTHY E. McGLINCHY, Director of Operations  
Central Mass. Mosquito Control Project  
111 Otis Street Northborough, Massachusetts 01532

### ABSTRACT

The Central Massachusetts Mosquito Control Project (CMMCP) has used the bio-pesticide *Bacillus thuringiensis var. israelensis* (Bti) since the late 1980's as the product of choice for mosquito larval control in area wetlands. The product efficacy evaluations performed each year are designed not only to check for Bti efficacy, but to monitor our application methods and amounts. Most areas showed nearly 100% control; some areas done by helicopter required follow up applications by ground equipment around the perimeter of the targeted wetlands. Our website at [www.cmmcp.org](http://www.cmmcp.org) has detailed information on this program. Bti will continue to be the foundation of our larval control program.

### INTRODUCTION

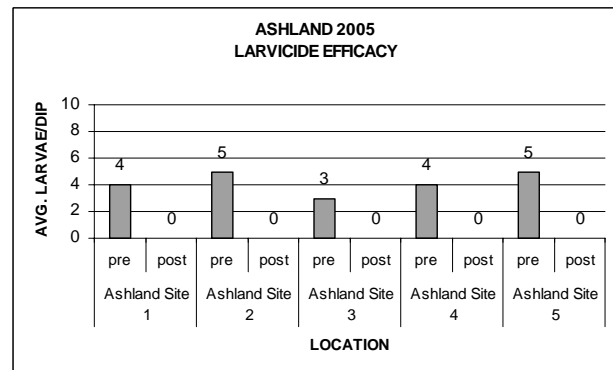
Larval control is the basis of an Integrated Mosquito Management (IMM) plan. Control of mosquitoes in the larval stage can show higher efficacy and lower non-target effects than other control methods, especially adulticiding. Broad-spectrum, chemical products available for larval control such as organophosphates have been used in the past by CMMCP, but we recognize the benefits of biocontrols such as Bti and have chosen this product over other products available for use, such as Abate®. Significant research has been done on Bti by researchers, university staff and mosquito control programs for many years, and the benefit-to-risk ratio is well documented.

### MATERIALS AND METHODS

Granular Bti can be applied in a variety of ways. It can be broadcast by hand, where the applicator can access areas not available to truck mounted equipment or aerial applications due to a heavy tree cover (canopy). Aircraft, either fixed wing or helicopter, can be used to deliver it to large, widespread areas inaccessible to any truck or hand applications because of size or location.

Label rates for applications are followed closely, and can range from 5 to 20 lbs per acre. Higher rates are recommended when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

The following graphs show pre- and post treatment data for 29 sites in 8 member towns from 2005. 2 sites are from the aerial program, and the other 6 are from ground applications. Post monitoring data is done from 24 to 48 hours after the original treatment. The website has detailed information on the collection data, with types of area, product amounts, larval instars, etc.





## RESULTS & DISCUSSION

All sites done by hand showed 100% control. A wider study of hand applications would certainly show lower efficacy, but 90% on average is not unexpected based on previous results. The aerial application showed a range of 0% to 100% control. The wide range of results is not surprising; our aerial efficacy program is more intensive, with 20 dips per every 250 acres set up as recoverable dip stations. Dip stations near the perimeter of the wetlands, roads or residential areas will not show good control due to the buffer zone employed by the helicopter pilots. Hand applications around the perimeters are often used to increase total efficacy from an area. Surveys conducted by the ground crews during post-monitoring noted that where Bti granular product was observed, very effective larval control was achieved.

**NOTE: REFERENCES FOR CLAIMS STATED HEREIN ARE AVAILABLE UPON REQUEST**

# A PRELIMINARY STUDY OF THE ATTRACTIVENESS OF OVITRAP CUPS IN COLLECTING CONTAINER SPECIES IN MASSACHUSETTS

TIMOTHY D. DESCHAMPS, Executive Director  
Central Mass. Mosquito Control Project  
111 Otis Street Northborough, Massachusetts 01532

## ABSTRACT

Using ovitraps to collect species data and to test for efficacy is a technique that has been well documented in many areas of mosquito control and research. A quick search on the Google website ([www.google.com](http://www.google.com)) using “Mosquito+Ovitrap” as the keywords turns up a wealth of information. In 2005 we employed ovitrap cups following the US Public Health Service & the Air Force Institute for Operational Health guidelines. Results were not entirely surprising, with *Oc. j. japonicus* as the predominant species, although *Oc. triseriatus* did not appear as anticipated, nor were any *Culex* identified. Ovitrap cups may be employed in the future by CMMCP to monitor population trends among the container species and for adulticide efficacy studies.

## INTRODUCTION

The goal at CMMCP this year was simple and straightforward – will mosquitoes use ovitraps if presented, and what species will we expect to sample? Can ovitraps be used as a device to monitor container species and check for adulticide efficacy?

## MATERIALS & METHODS

Ovitrap cups have been used at CMMCP in the past using coffee cans and seed germination paper. Dark colors are preferred by many container species of mosquitoes for oviposition (AFIOH website, Surveillance Methods/Ovitrap Collections). The coffee cans were painted black, but a source of seed germination paper can be hard to find once available stock is used up. To save on labor and to use materials readily available, the ovitraps will be designed according to the standards written by the US Public Health Service (figure 1). Black plastic cups with the CMMCP logo and “Mosquito Ovitrap” printed on the front were secured. Standard 6” hardwood tongue depressors and 8” natural (unbleached) paper towels were used to make the ovipaddle. A section of paper towel 8” square was cut and folded in half, then wrapped around the tongue depressor and secured at the top and bottom with office staples. A quarter-inch hole should be drilled in the cup 3.5 inches up from the bottom to prevent rainwater from overflowing the ovitrap. The cups may need to be secured in the area using a variety of methods such as a stone on the bottom, wired to a tree, etc.



Figure 1

10 ovitraps were placed in a wooded area with other container-breeding sources such as tarps, cans, etc. Each cup was filled with approximately 10 ounces of water from a nearby pond, and the cups were allowed to season for 1 week without the ovipaddle. After 1 week, the ovipaddles were placed in the cups and allowed to remain for 2 additional weeks. After 2 weeks the ovipaddles were collected, and the larvae present in the cups was placed in a single breeding chamber and reared to adult to determine species (table 1). The ovipaddles were allowed to desiccate and then the egg clusters on each ovipaddle were counted (table 2).

Several ovipaddles were submerged in water at a later date to encourage the eggs to hatch with the intent of identifying these to species. However most of the eggs did not successfully hatch, possibly due to extreme desiccation or exposure to high temperatures. The Air Force Institute for Operational Health recommendations are to place each ovipaddle in a sealed plastic bag, which should slow desiccation if the intent is to hatch at a later date (AFIOH website, Sorting, Packaging and Shipping Specimens).

**Table 1:**

| <b>ADULT IDENTIFICATION OF ALL HATCHED LARVAE IN OVITRAPS</b> |  |
|---|--|
| <i>Oc. j. japonicus</i> (11 male, 13 female)                  |  |

**Table 2:**

| <b>OVIPADDLE EGG COLLECTION COUNT</b> |      |            |      |
|---------------------------------------|------|------------|------|
| PADDLE 1:                             | 350+ | PADDLE 6:  | 350+ |
| PADDLE 2:                             | 275+ | PADDLE 7:  | 175+ |
| PADDLE 3:                             | 200+ | PADDLE 8:  | 350+ |
| PADDLE 4:                             | 250+ | PADDLE 9:  | 250+ |
| PADDLE 5:                             | 200+ | PADDLE 10: | 350+ |
| <b>AVERAGE PER CONTAINER – 275</b>    |      |            |      |

## CONCLUSION

As expected, *Oc. j. japonicus* dominated the collections. This species prefers cleaner water with less tannins than their counterparts *Oc. triseriatus* and *Culex* (Rutgers University, New Jersey Mosquito/Biology & Control website), and the pond water used would favor this species. If collections of *Oc. triseriatus* and *Culex* are the intended targets as well as *Oc. j. japonicus*, then water containing bacteria and tannins such as a hay infusion used in gravid traps should be used in the ovitraps.

Gravid females seemed to prefer to oviposit the eggs on the folded margins and on the dimples present on the oviposition substrate. The ovitraps collected an average of 275 eggs each over a 2 week period, and may be a useful device to monitor efficacy and to check for population trends among the container species especially if hay infusion water is used. The ovipaddles could also be collected and stored to be hatched at a later time for species composition, educational demonstrations, to check for larvicidal product efficacy, etc.

## REFERENCES

Air Force Institute for Operational Health (AFIOH) website:  
[http://www.brooks.af.mil/afioh/Health%20Programs/rsrh\\_ent\\_methods.htm](http://www.brooks.af.mil/afioh/Health%20Programs/rsrh_ent_methods.htm)

Rutgers University, New Jersey Mosquito/Biology & Control website:  
<http://www-rci.rutgers.edu/~insects/njspp.htm>

# ENVIRONMENTAL INFLUENCES FOR THE TREE CANOPY PREFERENCE OF *CULEX PIFIENS* AND *CULISETA MELANURA*

FRANK CORNINE, Surveillance Technician  
Central Mass. Mosquito Control Project  
111 Otis Street Northborough, Massachusetts 01532

Senior Thesis for Unity College, ME

## ABSTRACT

In our study we found that when mosquito collections were made on the same night and location, with one trap placed in the tree canopy and the other trap at ground level, there were a significantly higher number of *Culex pipiens* and *Culiseta melanura* in the tree canopy traps. These two trap levels also exhibited no significant difference in temperature, although it was determined that there was a significantly higher relative humidity at the ground level than in the canopy. This difference in relative humidity was also found to not be significantly correlated with the collections. By learning more about the biology of *Culex pipiens*, as well as other mosquitoes, we will be able to devise more effective methods to hamper their negative effects on humans without impacting other parts of the ecosystem.

## INTRODUCTION

Since the discovery of West Nile virus (WNV) in the United States in 1999, much emphasis has been placed on learning more about its transmission and characteristics of the specific mosquito species involved (Kulasekera, 2001; Nasci, 2001; Kilpatrick, 2005). The first known human case of WNV was reported in New York City, in August of 1999. After this first case there were an additional 61 humans positive for WNV in New York, from August to October of 1999, consisting mostly of elderly people (Enserink, 2000; Rappole, 2000). As of March 2005, WNV has infected over 17,000 and killed over 670 people in North America (Kilpatrick, 2005). From its initial discovery, WNV quickly spread across the U.S. and has made its way down into Mexico and Central America (Knight, 2003).

An important vector of WNV in the United States is the mosquito species *Culex pipiens* (Goddard, 2002; Anderson, 2004; Kilpatrick, 2005). It has been suggested that these mosquitoes act as hosts for overwintering flaviviruses such as WNV, until they reemerge in the spring (Goddard, 2002). Some studies suggest that *Culex pipiens*, along with *Culex restuans*, may in fact be responsible for up to 80% of human WNV infections in the northeast United States (Kilpatrick, 2005). Previously believed to feed mainly on birds, and therefore reducing their likelihood of infecting humans, *Culex pipiens* are now thought to more commonly feed on humans than previously thought (Kilpatrick, 2005). By learning more about the biology of *Culex pipiens*, as well as other mosquitoes, we will be able to devise more effective methods to hamper their negative effects on humans without impacting other parts of the ecosystem.

The vast majority of female adult mosquitoes require a blood meal to begin development of each clutch of eggs, and obtain this from a variety of sources (Bates, 1949; Knight, 2003). Most mosquito species will feed on warm-blooded animals after receiving cues to induce biting. These signals include carbon dioxide and ammonia, especially when coupled with a temperature and moisture level similar to breath (Bates, 1949). Respiration of animals, along with color, motion, and smell to a lesser degree attract the mosquitoes to feed upon various hosts (Bates, 1949). Some mosquitoes exhibit host preference while others do not. For example, past studies have the *Culex pipiens* species preferentially feeding on birds, but also feeding on assorted mammals (Nasci, 2001).

Once they have acquired their blood meal necessary for egg development, mosquitoes may use many different types of areas for breeding, including irrigated agricultural lands, shallow isolated pools, dumping areas, and wetlands (Knight, 2003). After obtaining a blood meal, the female mosquitoes will usually have a resting period before oviposition. It has been shown that mosquitoes don't lay eggs randomly but instead may lay eggs where there are fewer predators present (Kiflawi, 2003).

In many aspects of mosquito life history, temperature seems to play a very influential role. Low air temperatures in the winter lead many mosquito adults to enter a hibernation state and high temperatures in the summer can also lead to decreased adult mosquito activity (Knight, 2003). As noted before, temperature also plays an important role in the feeding habits of mosquitoes. *Culex pipiens* have been shown to prefer host temperatures between 32° C and 43°C, with temperatures above 49°C and below 30°C showing less attraction. Temperature also seems to have an effect on oviposition, with mosquitoes avoiding water temperatures outside the range of 20°C to 30°C (Bates, 1949).

There are several common trapping methods for adult mosquitoes. These include gravid traps that simulate oviposition habitat, light traps, and carbon dioxide traps with the latter two possibly being combined. With carbon dioxide being a major attractant for mosquitoes, yields from these traps are especially clean, containing almost no unwanted insects. The traps with light alone can produce many kinds of non-targeted insect species, which can slow research.

*Culex pipiens*, as well as other mosquito species, has been discovered to prefer inhabiting tree canopies, or at least seem to frequent tree canopy height. The specific reasons for this behavior are not clear although it has been speculated that they may be influenced by temperature, humidity, light, as well as the potential feeding of nesting birds (Anderson, 2004). This project was geared toward gathering data on two of these possibilities, temperature and humidity. My hypothesis is that *Culex pipiens* and *Culiseta melanura* will both show a significant preference for the canopy level, but that this will not have a significant relationship with either temperature or humidity.

## **METHODS**

Data collection for the project was started in late May 2005 and ended September 2, 2005. There were three different sites, two in Westborough, MA, and the other in neighboring Hopkinton. The two sites in Westborough were located off of Rogers St. (42°16.427'N, 071°36.033'W) and Hopkinton Rd. (42°15.709'N, 071°35.812'W), while the Hopkinton site was located off of Woods St. (42°15.354'N, 071°35.149'W).

Trapping involved using two CDC light/CO<sub>2</sub> mosquito traps (John W. Hock Co., model 512) with net collection bags, one placed approximately 6.5 meters into the air and the other about 1.5 meters high at the same site. Carbon dioxide was used as the only means of attractant, with the light feature of the traps being disabled to avoid non-target insects. The CO<sub>2</sub> tanks were adjusted with regulators to 15psi. On each trap there was a temperature/relative humidity data logger (Onset 64K HOBO Pro RH/Temp Logger) that logged each every 40 seconds while the trap was collecting.

The traps were set and collected overnight and retrieved approximately 24 hours later and set again usually at one of the other sites, with new collection bags, new batteries and new CO<sub>2</sub> tanks. The data logger information was downloaded and reset at each retrieval. The specimen collections were knocked down and stored in a refrigerator until identification. The specimens were identified as *Culex pipiens*, *Culiseta melanura*, or "other," by using the Darsie mosquito index (1981) and a dissecting microscope.

The data collected from the data loggers and mosquito identification was then used in several ANOVAs to determine whether there were significantly different findings for the two trap levels,

three trap sites, any interaction between those factors, and also for the temperature and relative humidity of the two trap levels. Significantly different mosquito numbers were then put through a test for normality and then a Spearman correlation test to determine if they were associated with any of the two possible environmental influences that were tested.

## RESULTS

There were 42 viable collections made, which included both canopy and ground traps along with complete temperature and relative humidity data sets. An ANOVA for the number of *Culex pipiens* caught was performed against the two trap levels and the three sites. It was then determined that there was a significantly higher number of these mosquitoes caught in the canopy traps than in the ground traps (figure 1), but no significant difference between any of the sites and any interactions within the trap levels and sites.

**Figure 1: Average # *Culex pipiens* at Canopy and Ground Trap Levels**



Similar results were found when an ANOVA was performed for the number of *Culiseta melanura* caught against the two trap levels and the three sites. There was a significantly higher amount of *Culiseta melanura* mosquitoes found in the canopy traps as opposed to the ground traps (Figure 2). Again, there was no significant difference between the number caught from the three sites or any interactions between the levels and sites.

When two-way ANOVAs were used with average temperature and average relative humidity against the trap levels and different sites, it was determined that there was a significant difference in the relative humidity readings of the canopy and ground level traps, but not in those of the average temperature of the two levels. There was no significant difference in the environmental factors between each site and also no significant difference in any interaction between trap level and site.

A test for normality showed that the mosquito collection data was not normal, and so the resulting Spearman correlation test showed that there was not a significant positive correlation between the *Culex pipiens* and *Culiseta melanura* canopy preference and the significantly different relative humidity of the two levels.

**Figure 2: Average # *Culiseta melanura* at Canopy and Ground Trap Levels**



## DISCUSSION

Our collections exhibited the canopy preference shown by *Culex pipiens* and other mosquitoes in previous studies (Anderson, 2004). Our study also showed that there was not a significant difference in the average temperatures of the two traps level. However, the relative humidity of the two levels did prove to be significantly difference, leading us to perform a correlation, which showed that there was not a significant relationship between relative humidity and collections.

Through the lack of a correlation, I believe our results seem to support the idea that the canopy preference is due more to the feeding habitat of these mosquitoes on roosting birds than abiotic environmental influences. The preference for obtaining blood meals through birds by *Culex pipiens* seems to be more behavioral than being influenced by certain environmental factors, temperature and relative humidity in this case. Our results support the possibility that these target mosquitoes are present in the canopy not because of the proposed abiotic factors but more likely because the dominant feeding patterns and the location of these organisms.

Because of the susceptibility of *Culex pipiens* and *Culiseta melanura* to acquire and transmit West Nile virus and also other diseases including Eastern Equine Encephalitis, it is important to know where they are predominantly located and also the reasons why. Previous studies along with this one seem to indicate that these mosquito species do prefer canopy level, which could be very influential in the control aspect of mosquito (Anderson, 2004). With the right thermal currents, a mosquito control application could be administered so that it would rise through the canopy, eliminating those targets before any virus is allowed to transfer and build in bird hosts. Lessening the amount of virus that bird host populations are exposed to could significantly decrease the chances of a mosquito with bird and mammal feeding preference to obtain virus and transmit it to humans.

Similar research of canopy preference of *Culex pipiens*, *Culiseta melanura* and other mosquito species, may lead mosquito surveillance projects to change their trapping protocol. By shifting the focus of surveillance techniques to the canopies as opposed to the standard ground level, there could be an increased chance of finding infected mosquitoes before they have a chance to infect birds, which would begin to build up the virus in themselves. Finding these infected mosquitoes before they have a chance to infect birds would give mosquito control projects a head start on signaling potentially high risk areas, and taking any proper actions.

These ideas were relevant during this project as one of the collections from a canopy trap was found to have West Nile virus. Signs were posted and a press release was announced, allowing local residents to take their own precautions to avoid contracting WNV. In response to these findings more traps were established in the local area, which later in the season resulted in a positive Eastern Equine Encephalitis pool of mosquitoes. These traps were located in an area that was frequented by children and senior citizens, emphasizing the importance of identifying it for infectious mosquitoes early.

In conclusion this study reinforces the canopy preference for *Culex pipiens* and *Culiseta melanura*. It was also found that there was no correlation between the canopy preference and canopy temperature and relative humidity. This finding leads one to believe that the canopy preference exhibited by these mosquitoes is influenced by something else, host availability being among the possibilities.

#### **ACKNOWLEDGMENTS**

This project was funded, in part, by a grant from Sigma Xi, #G200537105031856, Grant-in-Aid of Research program.

I would like to give a special thanks to the following people and groups, for their help and guidance throughout this project:

Dr. Amy Arnett  
Professor Barry Woods  
Dr. Emma Creaser

Curtis Best  
Timothy Deschamps  
Timothy McGlinchy  
Central Massachusetts Mosquito Control Project

---

**PLEASE NOTE: THIS THESIS IN ITS ORIGINAL FORMAT INCLUDING TABLES AND REFERENCES IS AVAILABLE ON THE CMMCP WEBSITE AT [www.cmmcp.org/cornine.pdf](http://www.cmmcp.org/cornine.pdf)**

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>       | <u>LOCATION</u>   |
|-------------|------------------------|---|
| 01-14-05    | Stream Cleaning 20'    | Whipple Road  |
|             | Stream Cleaning 20'    | Sesame Street   |
|             | Stream Cleaning 20'    | Rogers Street   |
|             | Stream Cleaning 20'    | Rogers Street   |
|             | Stream Cleaning 30'    | Rogers Street   |
|             | Stream Cleaning 25'    | Rogers Street   |
|             | Stream Cleaning 45'    | Rogers Street   |
|             | Culvert Cleaning (21)  | Astle Street, Melim Drive, French Street, Whipple Road, Sesame Street, Bopete Lane, Rogers Street, North Billerica Road, Geddes Drive, Heidenrich Drive                                     |
| 02-17-05    | Brush Cutting 215'     | Kendall Road  |
|             | Stream Survey          | Kendall Road  |
| 02-18-05    | Brush Cutting 230'     | Kendall Road  |
| 02-23-05    | Brush Cutting 150'     | Kendall Road  |
| 02-24-05    | Brush Cutting 150'     | Kendall Road  |
| 03-03-05    | Brush Cutting 60'      | Kendall Road  |
|             | Stream Cleaning 300'   | Kendall Road  |
| 03-04-05    | Stream Cleaning 400'   | Kendall Road  |
| 04-07-05    | Stream Survey          | Henry J. Drive  |
| 04-16-05    | Public Relations       | Mitchell G Drive, Alabama Road, Beech Street, Arlington Road, Chandler Street, Henry J. Drive, Pleasant Street, Westcott Circle, Windsor Drive, Hawthorne Circle, Andrea Drive, Adams Drive |
|             | Larval Survey          | Mitchell G. Drive, Arlington Street, Henry J. Drive Windsor Drive, Rogers Street, Andrea Drive  |
|             | Larviciding            | Alabama Road, Beech Street, Arlington Street, Chandler Street, Henry J. Drive, Pleasant Street, Westcott Circle, Hawthorne Circle, Charles Drive, Autumn Lane, Adams Road, Chapman Road     |
| 04-21-05    | Administrative         | Town Hall - Assessors   |
|             | Public Relations       | Pleasant Street, Marshall Street, North Billerica Road, Apple Tree Road, Whipple Road, Bridge Street, Allen Road, Pinnacle Street, Captain Circle, Bligh Street, Sawyer Lane, Louis Road    |
|             | Larval Survey          | Marshall Street, Apple Tree Road, Whipple Road, Bridge Street, Pinnacle Road, Scotland Drive, Sawyer Lane   |
|             | Larviciding            | Pleasant Street, Marshall Street, Seneca Road, North Billerica Road, Whipple Road, Bridge Street, Allen Road, Pinnacle Road, Captain Circle, Bligh Street, Sawyer Lane, Louis Road          |
| 04-25-05    | Administrative Contact | Town Hall - Clerk's Office  |
| 04-28-05    | Administrative Contact | Town Hall - Clerk's Office, Board Of Health   |
| 04-29-05    | Public Relations       | Charles Drive, Autumn Lane, Newton Avenue, Judith Street, McCarthy Way, Serenity Drive, Martin Road, Trull Road, Highland View Road   |
|             | Larval Survey          | Charles Drive, Hawthorne Circle, Autumn Lane, Newton Avenue, Pleasant Street, McCarthy Way, Sunny Slope Avenue, Highland View   |
|             | Larviciding            | Charles Drive, Newton Avenue, Pleasant Street, John Street, McCarthy Way, Serenity Drive, Martin Road, Trull Road, Highland View Road, Commerce Way   |
| 05-03-05    | Stream Survey          | Helvetia Road, Henry J. Drive, Rogers Drive   |
| 05-05-05    | Public Relations       | Astle Street, Rogers Street, Henry J. Drive, John Street, Foster Road, Main Street, South Street, Edgewood Road, Wayside Road, Mitchell G. Drive, Sand Piper Lane, Blacksmith Lane          |
|             | Larval Survey          | Henry J. Drive, Main Street, South Street, Edgewood Road, Wayside Road, Waterford Meadow Drive, Blacksmith Lane   |
|             | Larviciding            | Astle Street, Rogers Street, Henry J. Drive, John Street, Foster Road, Main Street, South Street, Starr Avenue, Mitchell G. Drive, Martha Avenue, Sand Piper Lane, Cooney Road              |
| 05-11-05    | Public Relations       | Marshall Street, Chandler Street, Sawyer Lane, Minute Man Way, River Road, Maple Wood Road, North Street  |
|             | Larval Survey          | Marshall Street, Scotland Drive, Green Meadow Road, River Road, Mt. Jay Drive, Minute Man Way, Manor Hill Drive, Chivas Circle, Fiske Street, Maple Wood Road, North Street                 |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>        | <u>LOCATION</u>  |
|-------------|-------------------------|--|
| 05-11-05    | Larviciding             | Marshall Street, Chandler Street, Sawyer Lane, Sheridan Lane, Long Meadow Road, Andover Street, Merrimack Meadows Lane, River Road, Mt. Jay Drive, Minute Man Way, River Road, Bridle Path, Fiske Street, Maple Wood Road  |
| 05-14-05    | Public Relations        | Old Boston Road, Washington Street, Seneca Road, Ginsburg Drive, Kennedy Road, Germano Drive   |
|             | Larval Survey           | Hillman Street, Clinton Street, Archstone Avenue, Main Street, Capital Avenue, Seneca Road, Kennedy Road, Rogers Street, Main Street, Woodland Drive, North Street   |
|             | Larviciding             | Duck Street, Hillman Street, Clinton Street, Washington Street, Old Boston Road, Archstone Avenue, Capital Avenue, Colab Road, Rogers Street, Ginsburg Drive, Secor Way, Woodland Drive, Germano Drive   |
| 05-16-05    | Administrative Contact  | Board Of Health  |
| 05-18-03    | Catch Basin Larviciding | Tewksbury Center School, John F. Ryan School, Tewksbury High School, North Street School, Health Brook School, Louise Davy Trahan School, John W. Wynn Middle School, Victor Drive, Loella F. Dewing School, Sawyer's Lane, Scotland Drive, Penny Lane, Bridle Path, Sheridan Lane, Waterford Marrow Drive, Merrimack Meadows Drive, Thorndike Lane, Minuteman Way, Manor Hill Drive, Germano Drive, Deering Drive, Fiske Street, Woodcrest Drive, Maplewood Road, Joseph Drive, Mount Joy Drive, Trull Road, Cleghorn Lane, Crest Road, Hood Road, Trull Brook Lane, Cobleigh Drive, Cooney Road, Black Smith Lane, Sandpiper Lane, Green Meadow Drive, Longmeadow Road, Merrimack Road, Chivas Circle, North Gate Road, East Gate Road, Marion Drive, Eaglet Landing, Eagle Drive, Emerald Court, Court Street, Stone Berry Crossing, Delaney Drive, Tewksbury Senior Center, Chandler Street, Blaire House, Erlin Terrance The Pine's, Stone Berry Crossing, Blaire House, Housing Authority - Chandler Street  |
| 05-23-05    | Catch Basin Larviciding | Charles Drive, Devon Shire Road, Hawthorne Circle, Tilton Circle, Farwood Road, Evergreen Road, Worthen Place, Wescott Circle, Langley Lane, Wellington Circle, Briarwood Road, Johnson Road, Lincoln Road, Tyler Road, Adams Road, Van Buren Street, Autumn Lane, Jefferson Road, Madison Road, Harrison Road, Saville Street, Carter Street, Dalton Street, Norfolk Street, Maureen Drive, Frederick Circle, Raymond Street, Donna Drive, Ferncroft Road, Catamount Road, Cayuga Road, Overlook Drive, Brentwood Drive, Kendall Road, Roper Lane, Randolph Drive, Juniper Lane, Primrose Circle, Mulberry Way, Quail Road, Lancaster Drive, Penncook Road, Meredith Road, Magna Vista Circle, Cardigan Road, Dike Court, Greylock Road, William G. Drive, Bonnie Lane, Heather Row, Sheffield Road, Pinnacle Street, Bligh Street, Captain Circle, Charles Drive, Dunvegan Road, Judique Road, Livingston Street, Karen Lee Lane, Lumber Lane, Carter Street, Regis Road, Old Cart Road, Cart Path Road, Peterson Way, Kimberly Drive, Leston Street, Quincy Road, Royal Crest Circle, Kingston Road, Cobbett Street, Ellington Road |
|             | [400]                   |  |
|             | [500]                   |  |
| 05-24-05    | Trap Site Survey        | Marion Drive   |
|             | Public Relations        | Marion Drive   |
| 05-28-05    | Catch Basin Larviciding | Summer Street, Dewey Street, Robinson Avenue, Tremblay Avenue, Helvetia Street, James Street, Harris Street, Heritage Drive, Jay Street, Crescent Street, Walter Street, Christine Drive, Carol Anne Road, Hillcrest Road, McKenzie Circle, John Smith Drive, Donovan Way, Henry J. Drive, Marcia Jean Drive, Leary Drive, Bruce Street, Erica Lane, Sandalwood Circle, John Street, Nightingale Lane, Arthur Road, Boisvert Road, Grasshopper Lane, Pocahontas Road, Indian Hill Road, Tomahawk Drive, Eleanor Road, Margaret Road, Delehanty Drive, Avon Street, Champion Street, Judith E. Drive, Belt Circle, Robert Circle, Chester Street, Chester Circle, Marie   |
|             | [375]                   |  |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>        | <u>LOCATION</u>   |
|-------------|-------------------------|---|
| 05-28-05    | Catch Basin Larviciding | Street, Blaire Street, Rutgers Street, Secor Way, Navillus Road, Seneca Road, Apple Tree Road, Edward Street, Kennedy Road, Pike Street, Fox Run Drive, Astle Street, Jodi Drive, Rolling Meadow, French Street, Babicz Road, Bopete Lane, Doherty Way, Sesame Street, O'Loughlin Drive, Pinta Drive, Andrea Drive, Nina Drive, Heidenrich Drive, Windsor Drive, Marston Street, Cinnamon Circle, McNeil Way, Catherwood Road, Marshall Street, Squire Lane, Tarella Circle, Jerome Road, Erlin Avenue, Nelson Avenue, Newton Avenue, Wilson Terrace, Newton Terrace, Erlin Terrace, Debra Drive, Pillsbury Avenue, Concrete Road, Munro Circle, Cross Street |
| 06-02-05    | Administrative Contact  | Department Of Public Works, Board Of Health, Police Department  |
|             | Public Relations        | Fox Run Drive, Ginsburg Road, Doherty Way, Westcott Circle, Lincoln Road, Pine Street, Whipple Road, Beech Street, Pinedale Avenue, Mitchell G. Drive, Jennies Way, Moonlight Drive, Pringle Street, South Street, South Street   |
|             | Landing Count           | Ginsburg Road, Doherty Way, Beech Street, Mitchell G. Drive   |
|             | Adulticiding            | South Street, Pringle Street, Moonlight Drive, Jennies Way, Mitchell G. Drive, Pinedale Avenue, Beech Street, Whipple Road, Pine Street, Lincoln Road, Wescott Circle, Charles Drive, Doherty Way, Ginsburg Road  |
| 06-06-05    | Set Trap                | Marion Drive  |
| 06-07-05    | Administrative Contact  | Department Of Public Works, Board Of Health, Police Department  |
|             | Public Relations        | Marion Drive, Newton Avenue, Squire Lane, Marston Street, Pleasant Street, Debra Drive, Chandler Street, Foster Street, Easement Road, Joanne Drive, Ronald Drive, Amos Street, Arlington Street, Sharon Street, Beech Street, New Mexico Road, Oregon Road, McCarthy Way, Louisiana Road, Ash Street, McLaren Road   |
|             | Larval Survey           | Newton Avenue, Pleasant Street, Joanne Drive, Sharon Street   |
|             | Larviciding             | Pleasant Street   |
|             | Adulticiding            | Easement Road, Chandler Street, Debra Drive, Pleasant Street, Marston Street, Squire Lane, Newton Avenue, McLaren Road, Ash Street, Whalen Road, Carolina Road, Louisiana Road, McCarthy Way, Oregon Road, New Mexico Road, Beech Street, Sharon Street, Arlington Street, Amos Street, Ronald Drive, Joanne Drive  |
| 06-09-05    | Pick Up Trap            | Marion Drive  |
|             | Administrative Contact  | Police Department   |
|             | Public Relations        | Catamount Street, Rogers Street, Boisvert Road, Martha Avenue   |
|             | Adulticiding            | Catamount Street, Rogers Street, Boisvert Road, Martha Avenue   |
| 06-13-05    | Administrative Contact  | Police Department, Board Of Health  |
|             | Public Relations        | Trull Road, Martin Road, Mount Joy Drive, Blacksmith Lane, Water Ford Meadows Road, Wood Crest Road, Sawyer Lane, Manor Hill Road, Andover Street, Germano Drive, North Gate Road, Louis Road, Westland Road, North Street, Cayuga Road, Main Street, Janet Avenue,   |
|             | Adulticiding            | North Gate Road, Germano Drive, Manor Hill Road, Sawyer Lane, Waterford Meadows Drive, Black Smith Lane, Mt. Joy Drive, Trull Road, Martin Road, Main Street, Janet Avenue, North Street, Westland Road, Louis Road, North Gate Road, Living Stone Ball Fields  |
| 06-14-05    | Set Trap                | Marion Drive  |
| 06-16-05    | Pick Up Trap            | Marion Drive  |
|             | Administrative Contact  | Police Department   |
|             | Public Relations        | Melim Drive, Kennedy Road, Henry J. Drive, Rhoda Street, Chuck's Way, Salem Avenue, Vernon Street, Temple Street, Green Street, Lawrence Street, Fitz Terrace, South Street, Brown Street, Arkansas Road, Louisiana Road,   |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>  | <u>LOCATION</u>  |
|-------------|---|--|
| 06-16-05    | Public Relations<br><br>Larval Survey<br>Adulticiding   | Florida Road, Carolina Road, Michigan Road, Eighth Street, Catamount Street, Westland Drive, Louis Road, Blacksmith Lane, Andover Street, Woodcrest Road, Manor Hill Drive, Kimberly Drive, East Street, Lancaster Drive, Redgate Road, Barry Drive, Martha Avenue, Meredith Road, Heather Row, Bonnie Lane, Cardigan Road, Kendall Road, Pinnacle Road, Manor Hill Drive<br>Eighth Street, Michigan Road, Carolina Road, Florida Road, Louisiana Road, South Street, Fitz Terrace, Arkansas Road, Brown Street, Green Street, Laurence Street, Temple Street, Vernon Street, Salem Road, Chuck's Way, Rhonda Street, Henry J. Drive, Kennedy Road, Melim Drive, Catamount Street, Westland Drive, Louis Road, Blacksmith Lane, Andover Street, Woodcrest Road, Manor Hill Drive, Kimberly Drive, East Street, Lancaster Drive, Redgate Road, Barry Drive, Martha Avenue, Lancaster Drive, Meredith Road, Heather Row, Bonnie Lane, Cardigan Road, Kendall Road, Pinnacle Road, Lancaster Road   |
| 06-17-05    | Administrative Contact<br>Public Relations<br><br>Laval Survey<br>Landing Count<br>Adulticiding | Police Department<br>Indian Hill Road, Tomahawk Drive, French Street, Astle Street, Pike Street, Fox Run, Navillus Road, Rogers Street, McNeil Way, Marston Street, Van Buren Road, Lincoln Road, Worthen Place, Wescott Circle, Whipple Road, Squire Lane, Jerome Road, Newton Avenue, Monroe Circle, Pleasant Street, Henry J. Drive, Marcia Jean Road, Foster Road, Clair Street, Carnation Drive, Neptune Road, Old Main Street, Sesame Street, Main Street, Navillus Street, Squire Lane, Lee Street, Pringle Street, Mitchell G. Drive, Shawsheen Street, Brookfield Road, Wayside Road, Windham Road, Bridge Street, Crawford Drive, Poplar Street<br>Neptune Street<br>Tomahawk Drive<br>Indian Hill Road, Tomahawk Drive, Carnation Drive, Clair Street, Foster Road, Marcia Jean Drive, Henry J. Drive, Pleasant Street, Monroe Circle, Newton Avenue, Jerome Road, Squire Lane, Whipple Road, Wescott Circle, Marston Street, Lincoln Road, Van Buren Road, McNeil Way, Rogers Street, Navillus Road, Fox Run French Street, Pike Street, Astle Street, Neptune Road, Old Main Street, Sesame Street, Main Street, Navillus Street, Squire Lane, Lee Street, Pringle Street, Mitchell G. Drive, Shawsheen Road, Brookfield Road, Wayside Road, Windham Road, Bridge Street, Crawford Drive, Poplar Street |
| 06-20-05    | Set Trap  | Marion Drive   |
| 06-21-05    | Pick Up Trap  | Marion Drive   |
| 06-22-05    | Administrative Contact<br>Public Relations<br><br>Landing Count<br>Adulticiding                 | Police Department, Board Of Health<br>Kimberly Drive, Lee Street, Kendall Road, Roper Lane, Saville Street, Whipple Road, Chandler Street, Judith E. Drive, Foster Road, Kent Street, Ronald Drive, Colonial Drive, David Morris Road, Chester Street, Amos Street, Claire Street, Sharon Street, Michael Street, Chandler Street, East Street<br>Kendall Road, Saville Street, Chandler Street, Ronald Drive, East Street<br>Whipple Road, Tewksbury Town Houses, Villa Roma Condominiums, East Street, Chandler Street, Michael Street, Sharon Street, Hebert Street, Ida Street, Rhoda Street, Oliver Street, Amos Street, Claire Street, Chester Street, Marie Street, Erica Lane, David Morris Road, Colonial Drive, Ronald Drive, Kent Street, Foster Road, Judith E. Drive, Whipple Road, Chandler Street, Whipple Road, Dalton Street, Carver Street, Saville Street, Roper Lane, John Street, Kendall Road, Lee Street, Kimberly Drive  |
| 06-22-05    | Adulticiding<br>(Continued)   |  |
| 06-24-05    | Administrative Contact  | Police Department  |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>                           | <u>LOCATION</u>   |
|-------------|--|---|
|             | Public Relations                           | Kendall Road, Lancaster Drive, North Street, Louis Road, Washington Street, Court Street, Old Boston Road, South Street, Shawsheen Street, Cart Path Road, Mitchell G. Drive, Livingston Street, Dunvegan Road, Bligh Street, Captain Circle, Kendall Road, Brentwood Road,   |
| 06-24-05    | Public Relations                           | Cayuga Road, North Street, Cardigan Road, Main Street, Stone Berry Crossing, McLaren Road, Miles Road, Oregon Road, Fourth Street, Carolina Road, Water Street, Main Street, Salem Road, County Road, Baldwin Street, Pringle Street, Janet Avenue, Columbia Road, Valley Road, Shawsheen Street, Driftwood Drive, Foster Road, Colonial Drive, Boisvert Road, Pine Street, Pleasant Street, Marston Street, Astle Street, Fox Run Drive, Van Buren Road, Newton Avenue, Cabot Road, Fourth Street, Helvetia Street, Whipple Road   |
|             | Larval Survey<br>Landing Count             | Kendall Road, Lancaster Drive<br>Court Street, North Street, Louis Street, Astle Street, Pleasant Street, Colonial Drive, Carolina Road, Pringle Street   |
|             | Adulticiding                               | North Street, East Street, Cardigan Road, Cayuga Road, Louis Road, Brentwood Road, Kendall Road, Bligh Street, Captain Circle, Lancaster Drive, Mitchell G. Drive, Cart Path Road, Shawsheen Street, South Street, Court Street, Old Boston Road, Washington Street, Livingston Street, Main Street, Whipple Road, Van Buren Road, Helvetia Street, Columbia Road, Laurie Way, Janet Avenue, Pringle Street, Baldwin Street, County Road, Valley Road, Salem Road, McLaren Road, Ryan's Way, Main Street, Parker Avenue, Water Street, Carolina Road, Miles Road, Oregon Road, Fourth Street, Driftwood Drive, Shawsheen Street, Pine Street, Boisvert Road, Foster Road, Colonial Drive, Pleasant Street, Newton Avenue, Marston Street, Fox Run Drive, Astle Street, Stone Berry Crossing |
| 06-27-05    | Set Trap                                   | Marion Drive  |
| 06-28-05    | Administrative Contact<br>Public Relations | Police Department, Board Of Health<br>Rogers Street, Navillus Road, French Street, Melrose Avenue, Briarwood Road, Autumn Lane, Newton Terrace, Quail Run, Hodgson Street, Marie Street, Oxford Street, South Street, St. Mary's Road,  |
|             | Landing Count                              | Navillus Road, Trull Road, Whited Avenue, Andover Street, Sandpiper Lane, Fiske Street, North Gate Road, Bligh Street, Pinnacle Street, Sunset Circle, Moonlight Drive, King Fisher Road, Mitchell G. Drive, Wayside Road, South Street, Sciarappa Way, East Street, Lee Street, Neptune Street, Lancaster Drive, Bonnie Lane, Brentwood Road, Livingston Street  |
|             | Adulticiding                               | Trull Road, Whited Avenue, Andover Street, Sandpiper Lane, Fiske Street, North Gate Road, Pinnacle Street, Bligh Street, Sunset Circle, Moonlight Drive, Kingfisher Road, Mitchell G. Drive, Wayside Road, South Street, Sciarappa Way, East Street, Lee Street, Neptune Street, Lancaster Drive, Bonnie Lane, Livingston Street, Brentwood Road, Village Of Tewksbury Condominiums, Apache Way Condominiums, Kevin Street, Darby Street, Hodgson Street, Foster Road, Patrick Road, Dipalma Estates, Juniper Lane, Primrose Circle, Beech Street, Newton Terrace, Briarwood Road, French Street, Rogers Street, Navillus Road, Melrose Avenue, Autumn Lane, St Mary's Road, South Street, Oxford Street, Marie Street  |
|             | Pick Up Trap                               | Marian Drive  |
| 06-30-05    | Administrative Contact<br>Public Relations | Police Department<br>Kendall Road, Catamount Road, Eighth Street, Recreation Department - Livingston Street Park  |
|             | Adulticiding                               | Catamount Road, Kendall Road, Eighth Street, Catamount Road, Recreation Department - Livingston Street Park   |
| 07-07-05    | Administrative Contact<br>Public Relations | Police Department<br>Stoneybury Way, Main Street, Kimberly Drive, Lees Street, Salem Road, Glenwood Road, Fitz Terrace, Temple Street,  |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>                           | <u>LOCATION</u>  |
|-------------|--|--|
|             | Adulticiding                               | South Street, Oregon Road, McLaren Road, Arlington Street, Shawsheen Street  |
| 07-11-05    | Administrative Contact<br>Public Relations | Main Street, Quail Run Condominiums, Shawsheen Street, Arlington Street, McLaren Road, Oregon Road, South Street, Temple Street, Fitz Terrace, Glenwood Road, Salem Road, Kimberly Drive, Lee Street<br>Police Department, Board Of Health   |
|             | Landing Count                              | North Street, Louis Road, North Gate Road, Maplewood Road, Cardigan Road, Pinnacle Street, Lancaster Drive, Karen Lee Lane, Cobbett Street, Bligh Street, South Street, Shady Lane, Shawsheen Street, Compass Lane, Pringle Street, Pinedale Avenue, Mitchell G. Drive, North Street   |
|             | Adulticiding                               | Lancaster Drive, Shady Lane, Pringle Street, Mitchell G. Drive   |
|             | Set Trap                                   | South Street, Shawsheen Street, North Street, Louis Road, North Gate Road, Maplewood Road, Cardigan Road, Lancaster Drive, Pinnacle Street, Bligh Street, Cobbett Street, Karen Lee Lane, Mitchell G. Drive, Pinedale Avenue, Pringle Street, Shady Lane, Compass Lane, Delwood Road   |
| 07-12-05    | Pick Up Trap                               | Marion Drive   |
| 07-14-05    | Public Relations                           | Marion Drive<br>Whipple Road, Rogers Street, Charles Drive, Wescott Circle, Lincoln Road, Autumn Lane, Pleasant Street, Pine Street, Henry J. Drive, Marcia Jean Drive, Foster Road, Beech Street, Ronald Drive, Florida Road, Michigan Road, South Street, White Street, Pine Street, Carleton Road, Polaris Lane, Cobbett Lane, North Street, Catamount Road, Louis Road, Ward Street, Neptune Street, Pike Street, French Street, Astle Street, Melim Drive, Serenity Drive, Charles Drive, Rogers Street |
|             | Landing Count                              | Ronald Drive, Florida Road, Pine Street  |
|             | Adulticiding                               | Neptune Street, Melim Drive, Astle Street, French Street, Pike Street, Ward Street, North Street, Louis Road, Catamount Road, Cobbett Street, Polaris Lane, Serenity Drive, Carleton Road, Rogers Street, Charles Drive, Foster Road, Whipple Road, Wescott Circle, Autumn Lane, Lincoln Road, Pleasant Street, Pine Street, Henry J. Drive, Marcia Jean Drive, South Street, Ronald Drive, Michigan Road, Florida Road, White Street, Beech Street, John Street, Stonebury Condominiums                     |
| 07-18-05    | Larviciding                                | Autumn Lane  |
|             | Set Trap                                   | Marion Drive   |
| 07-19-05    | Pick Up Trap                               | Marion Drive   |
| 07-20-05    | Administrative Contact<br>Public Relations | Police Department, Board Of Health<br>Eagle Drive, Stonebury Way, Livingston Street, Navillus Road, Marston Street, Whipple Road, French Street, Dalton Street, Foster Road, Sharon Road, Shawsheen Street, South Rhoda Street, Heath Street, South Street, Pringle Street, South Street, Karen Lee Lane, Judique Road, Kendall Road, Hood Road, North Street, Louis Road, Susan Drive, French Street  |
|             | Landing Count                              | South Street, Karen Lee Lane, North Street   |
|             | Adulticiding                               | Sharon Road, Anthony Road, Louis Road, North Street, Hood Road, Trull Brook Lane, Kendall Road, Judique Road, Karen Lee Lane, Shawsheen Street, South Street, Pringle Street, Whipple Road, Livingston Street  |
| 07-20-05    | Adulticiding<br>(Continued)                | Fields, French Street, Navillus Road, Kennedy Street, Marston Street, Dalton Street, Otis Street, Susan Drive, Foster Road, Hodgson Street, Heath Street, Shawsheen Street   |
| 07-25-05    | Public Relations                           | Marion Drive   |
|             | Set Trap                                   | Marion Drive   |
| 07-26-05    | Administrative Contact<br>Public Relations | Police Department, Town Clerk, Board Of Health<br>Pringle Street, Crawford Drive, South Street, Whipple Street, Lloyed Road, Main Street, John Street, Westcott Circle, Chapman Road, Pleasant Street, Rogers Street, McNeil Way, French Street, Neptune Street, North   |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>       | <u>LOCATION</u>  |
|-------------|------------------------|--|
|             |                        | Street, Louis Road, Lancaster Drive, Pinnacle Road, Lowe Street, Level Lane, South Street, Regina Drive, Shawsheen Street, Lee Street  |
|             | Adulticiding           | North Street, Louis Road, Lancaster Drive, Pinnacle Road, Lowe Street, Level Lane, South Street, Regina Drive, Shawsheen Street, Pringle Street, Crawford Drive, East Street Baseball Fields, South Street, Lloyd Road, Reagan Road, Cynthia Road, Whipple Road, Main Street, Johns Street, Pleasant Street, Chapman Road, Westcott Circle, McNeil Way, Rogers Street, French Street, Neptune Street |
| 07-26-05    | Adulticiding           |  |
|             | Pick Up Trap           | Marion Drive   |
| 07-27-05    | Set Trap               | Trull Road   |
| 07-28-05    | Administrative Contact | Police Department  |
|             | Public Relations       | Babicz Road, Silver Smith Way  |
|             | Adulticiding           | Babicz Road  |
|             | Pick Up Trap           | Trull Road   |
|             | Set Trap               | Pringle Street   |
| 07-29-05    | Pick Up Trap           | Pringle Street   |
| 08-01-05    | Administrative Contact | Police Department, Board Of Health   |
|             | Public Relations       | Main Street, Lee Street, Catamount Road, William G Drive, Livingston Street, East Street, Valewood Circle Shawsheen Street, South Rhoda Street, Pine Street, Dalton Street, Beech Street, Brown Street, Arlington Street, Temple Street,   |
|             | Landing Count          | Pine Street  |
|             | Adulticiding           | Dalton Street, Pine Street, Beech Street, Brown Street, Temple Street, Shawsheen Street, South Rhoda Street, Wayside Road, Arlington Street, Valewood Circle, East Street, Livingston Street, William G Drive, Catamount Road, Lee Street, Main Street   |
|             | Set Trap               | Marion Drive, Louis Road   |
| 08-02-05    | Pick Up Trap           | Marion Drive, Louis Street   |
|             | Set Trap               | Trull Road   |
| 08-03-05    | Pick Up Trap           | Trull Road   |
|             | Set Trap               | Main Street  |
| 08-04-05    | Administrative Contact | Police Department  |
|             | Public Relations       | Hood Road, 7 <sup>th</sup> Street, Louis Road, Marion Drive, Wayside Road, Salem Road  |
|             | Adulticiding           | Hood Road, 7 <sup>th</sup> Street, Louis Road, Wayside Road, Salem Road  |
| 08-08-05    | Set Trap               | Marion Drive   |
| 08-09-05    | Pick Up Trap           | Marion Drive   |
| 08-10-05    | Administrative Contact | Police Department  |
|             | Public Relations       | North Street, Louis Road, Kendall Road, Pinnacle Street, Martha Avenue, Mitchell G. Drive, Redgate Road, Valewood Circle, Wamesit Road, Oregon Road, Beech Street, Kevin Street, Shawsheen Street, South Rhoda Street, Davis Road, Colonial Drive, Maureen Drive, Pleasant Street, Debra Drive, Westcott Circle, Rogers Street   |
|             | Adulticiding           | Westcott Circle, Debra Drive, Pleasant Street, Maureen Drive, Colonial Drive, Davis Road, Kevin Street, Beech Street, Shawsheen Street, Oregon Road, Wamsit Road, Valewood Circle, Redgate Road, Mitchell G. Drive, Martha Avenue, Pinnacle Street, Kendall Road, Louis Road, North Street, Rogers Street  |
| 08-11-05    | Public Relations       | Primrose Circle  |
| 08-15-05    | Set Trap               | Marion Drive   |
| 08-16-05    | Administrative Contact | Police Department, Board Of Health, Town Clerk   |
|             | Public Relations       | McNeil Way, Kennedy Road, French Street, Pleasant Street, Helvetia Street, Driftwood Drive, McCarthy Way, Ash Street, South Street, Water Street, Oakland Avenue   |
|             | Adulticiding           | Main Street, Glenwood Avenue, Sandy Lane, South Street, Helvetia Street, Lincoln Street, McNeil Way  |
|             | Larval Survey          | Kennedy Road, French Street, Pleasant Street, Driftwood Drive, McCarthy Way, Oregon Road, Ash Street, South Street, Water Street, Oakland Avenue   |
|             | Larviciding            | McCarthy Way, McLaren Road, County Road  |
|             | Pick Up Trap           | Marion Drive   |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>  | <u>LOCATION</u>  |
|-------------|---|--|
| 08-17-05    | Administrative Contact<br>Public Relations<br>Adulticiding  | Police Department<br>Debra Drive<br>Debra Drive  |
| 08-18-05    | Administrative Contact<br>Public Relations<br>Adulticiding  | Police Department<br>Trull Road, Chapman Road, Sesame Street, Shawsheen Street<br>Trull Road, Chapman Road, Sesame Street, Shawsheen Street  |
| 08-22-05    | Administrative Contact<br>Public Relations<br><br>Adulticiding<br><br>Larval Survey<br><br>Larviciding<br>Set Trap                                    | Police Department, Board Of Health<br>Pleasant Street, Neptune Street, Louis Road, Pinnacle Street, Breckenridge Road, Vale Street, Anthony Road, Shawsheen Street, Bridge Street, South Street<br>Neptune Street, Pinnacle Street, Breckenridge Road, Walnut Road, Temple Street, Pleasant Street<br>Breckenridge Road, Shawsheen Street, Vale Street, Meade Street, Old Stage Coach Road, Shawsheen Street, Bridge Street, South Street<br>Shawsheen Street, South Street<br>Marion Drive      |
| 08-23-05    | Pick Up Trap  | Marion Drive   |
| 08-25-05    | Administrative Contact<br>Public Relations<br><br>Adulticiding<br><br>Larval Survey<br><br>Larviciding  | Police Department, Board Of Health<br>Evergreen Road, Shawsheen Street, Arlington Street, Brookfield Road, South Street, Louie Street, Starr Avenue, Vale Street, Louis Road, Germaine Drive<br>Starr Avenue, Shawsheen Street, Arlington Street, Vale Street, South Street, Brookfield Road, Louis Road, Evergreen Road<br>Shawsheen Street, Vale Street, North Street, Germaine Drive, Catamount Road, Kendall Road, Woodland Drive<br>Louis Road, Woodland Drive, Livingston Street           |
| 08-29-05    | Set Trap  | Marion Drive   |
| 08-30-05    | Pick Up Trap  | Marion Drive   |
| 08-31-05    | Administrative Contact<br>Public Relations<br><br>Stream Cleaning 30'<br>Culvert Cleaning (1)<br>Adulticiding<br><br>Larval Survey<br><br>Larviciding | Police Department, Board Of Health<br>Chandler Street, Marion Drive, Deering Road, Starr Avenue, Pringle Street<br>Martha Avenue<br>Martha Avenue<br>Deering Drive, Marion Drive, Martha Avenue, Starr Avenue, Pringle Street, Chandler Street<br>Chandler Street, Old Boston Road, Deering Avenue, Starr Avenue, Maplewood Road, Martha Avenue, Mitchell G. Drive, Mill Street, South Street<br>Chandler Street, Main Street, Mitchell G. Drive, Mill Street                                    |
| 09-08-05    | Administrative Contact<br>Public Relations<br><br>Adulticiding  | Police Department, Board Of Health, Town Clerk<br>North Street, Louis Road, Saville Street, Oregon Road, Main Street, Lee Street<br>Newton Avenue, North Street, Lois Road, North Street, Lee Street, Main Street, Saville Street, Maureen Drive, Oregon Road  |
| 09-12-05    | Set Trap  | Marion Drive   |
| 09-13-05    | Administrative Contact<br>Public Relations<br><br>Adulticiding<br><br>Larval Survey<br><br>Larviciding<br>Pick Up Trap                                | Police Department<br>County Road, Pleasant Street, Rogers Road, Westcott Circle, French Street, Astle Street, Neptune Road, Louis Road, Country Club Drive<br>Country Club Drive, Country Road, Roger Street, Pleasant Street, Westcott Circle, Astle Street, Louis Road, Neptune Road<br>Country Club Drive, Country Road, Rogers Road, Pleasant Street, Westcott Circle, French Street, Neptune Street, Marion Road<br>Astle Street, Trull Street, Martha Street, Starr Avenue<br>Marion Drive |
| 09-14-05    | Administrative Contact<br>Public Relations<br>Adulticiding  | Police Department<br>French Street, Starr Avenue, Louis Road<br>French Street, Starr Avenue, Louis Road  |
| 09-15-05    | Administrative Contact<br>Public Relations<br>Stream Cleaning 40'<br>Stream Cleaning 40'<br>Stream Cleaning 50'                                       | Police Department<br>Patricia Drive, Oregon Road<br>South Street<br>South Street<br>South Street   |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>       | <u>LOCATION</u>  |
|-------------|------------------------|--|
|             | Stream Cleaning 25'    | South Street   |
|             | Stream Cleaning 25'    | Janet Way  |
|             | Stream Cleaning 20'    | Brown Street   |
|             | Stream Cleaning 25'    | Kendall Street   |
|             | Stream Cleaning 20'    | Kendall Street   |
| 09-15-05    | Culvert Cleaning       | Mitchell G Drive, Shawsheen Street, Indian Ridge, South Street, Pringle Road, Valley Road, Country Road, Janet Way, Brown Street, Livingston Street, Lancaster Street, Kendall Street  |
|             | Adulticiding           | Patricia Drive, Oregon Road, Livingston Fields   |
| 09-19-05    | Set Trap               | Marion Drive, Wolcott Street   |
| 09-20-05    | Pick Up Trap           | Marion Drive, Wolcott Street   |
|             | Set Trap               | Wolcott Street   |
| 09-21-05    | Administrative Contact | Police Department  |
|             | Public Relations       | Ryan's Way, Charles Drive  |
|             | Adulticiding           | Ryan's Way, Charles Drive, North Street, Livingston Street Fields  |
|             | Pick Up Trap           | Walcott Street   |
|             | Set Trap               | Walcott Street   |
| 09-22-05    | Pick Up Trap           | Walcott Street   |
|             | Set Trap               | Walcott Street   |
| 09-23-05    | Pick Up Trap           | Walcott Street   |
| 09-26-05    | Set Trap               | Marion Drive, Walcott Street   |
| 09-27-05    | Pick Up Trap           | Marion Drive, Walcott Street, Seneca Road, Navillus Road   |
|             | Set Trap               | Marion Drive, Walcott Street, Seneca Road, Navillus Road   |
| 09-28-05    | Pick Up Trap           | Marion Drive, Walcott Street, Seneca Road, Navillus Road   |
|             | Set Trap               | Marion Drive, Walcott Street, Seneca Road, Navillus Road   |
| 09-30-05    | Pick Up Trap           | Seneca Road, Navillus Road   |
| 10-17-05    | Public Relations       | French Street, Rogers Street, Meadow Land Court  |
|             | Stream Cleaning 15'    | Astle Street   |
|             | Stream Cleaning 20'    | Astle Street   |
|             | Stream Cleaning 20'    | French Street  |
|             | Stream Cleaning 15'    | French Street  |
|             | Stream Cleaning 20'    | Whipple Road   |
|             | Stream Cleaning 20'    | Rogers Street  |
|             | Stream Cleaning 20'    | Rogers Street  |
|             | Stream Cleaning 15'    | Rogers Street  |
|             | Stream Cleaning 20'    | Rogers Street  |
|             | Stream Cleaning 30'    | Rogers Street  |
|             | Stream Cleaning 20'    | Rogers Street  |
|             | Culvert Cleaning (23)  | Astle Street, French Street, Whipple Road, Dairy Farm Way, Rogers Street, Andrea Drive, Heidenrich Drive, North Billerica Road, Geddes Drive, Charles Road, Hawthorne Circle   |
| 10-21-05    | Public Relations       | Pinnacle Street  |
|             | Stream Survey          | Pinnacle Street, Beech Street, Heath Brook School  |
| 11-15-05    | Stream Cleaning 20'    | Long Meadow Road   |
|             | Stream Cleaning 15'    | Trull Brook Lane   |
|             | Stream Cleaning 35'    | Sand Piper Lane  |
|             | Stream Cleaning 30'    | Andover Road   |
|             | Stream Cleaning 15'    | Andover Road   |
|             | Stream Cleaning 30'    | Chivas Circle  |
|             | Stream Cleaning 15'    | Fiske Street   |
|             | Stream Cleaning 40'    | Maplewood Road   |
|             | Culvert Cleaning (27)  | Trull Road, Longmeadow Road, Trull Brook Lane, Andover Road, Water Ford Meadows Drive, Sand Piper Lane, River Road, Merrimack Meadow Lane, Mt. Joy Drive, Minuteman Drive, Manner Hill Drive, Chivas Circle, Fiske Street, Scotland Drive, Sawyer Lane, Maplewood Road, Sheridan Lane, Green Meadow Drive, Robertson Estates |
| 11-30-05    | Stream Cleaning 25'    | Marshall Street  |
|             | Stream Cleaning 30'    | Pleasant Street  |
|             | Stream Cleaning 15'    | Debra Drive  |
|             | Stream Cleaning 30'    | Debra Drive  |
|             | Stream Cleaning 15'    | Pleasant Street  |
|             | Stream Cleaning 15'    | Pleasant Street  |
|             | Stream Cleaning 15'    | Patriot Way  |
|             | Stream Cleaning 10'    | Patriot Way  |
|             | Stream Cleaning 25'    | Patriot Way  |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>      | <u>LOCATION</u>  |
|-------------|-----------------------|--|
|             | Stream Cleaning 15'   | Helvetia Street  |
|             | Stream Cleaning 15'   | Helvetia Street  |
|             | Stream Cleaning 20'   | Bruce Street   |
|             | Stream Cleaning 20'   | Henry J. Drive   |
|             | Stream Cleaning 15'   | Whipple Road   |
|             | Stream Cleaning 15'   | Oxford Road  |
|             | Stream Cleaning 20'   | Sycamore Street  |
|             | Stream Cleaning 20'   | Erica Lane   |
|             | Stream Cleaning 15'   | Marie Street   |
|             | Culvert Cleaning (27) | Main Street, Marshall Street, Pleasant Street, Debra Drive, Pleasant Street, Patriot Way, Helvetia Street, Henry J. Drive, Bruce Street, Pine Street, Pond Street, Whipple Road, Raymond Street, Oxford Road, Beech Street, Erica Lane, Marie Street                 |
| 12-06-05    | Public Relations      | Heather Row  |
|             | Stream Cleaning 40'   | North Street   |
|             | Stream Cleaning 25'   | Randolph Drive   |
|             | Stream Cleaning 25'   | Kendall Road   |
|             | Stream Cleaning 20'   | Kendall Road   |
|             | Stream Cleaning 50'   | Kendall Road   |
|             | Stream Cleaning 30'   | Leighton Lane  |
|             | Stream Cleaning 20'   | William G. Drive   |
|             | Stream Cleaning 15'   | Heather Row  |
|             | Stream Cleaning 20'   | Heather Row  |
|             | Stream Cleaning 30'   | Bonnie Lane  |
|             | Stream Cleaning 25'   | Cardigan Road  |
|             | Stream Cleaning 25'   | Dike Court   |
|             | Stream Cleaning 25'   | Kendall Road   |
|             | Stream Cleaning 10'   | Pennacook Road   |
|             | Stream Cleaning 10'   | Meredith Road  |
|             | Stream Cleaning 10'   | Lancaster Drive  |
|             | Culvert Cleaning (27) | North Street, Randolph Drive, Kendall Road, Leighton Lane, Kendall Road, William G. Drive, Heather Row, Bonnie Lane, Cardigan Road, Dike Court, Brentwood Road, Livingston Street, Pennacook Road, Meredith Road, Lancaster Drive, Magna Vista Circle, Pinnacle Road |
| 12-08-05    | Public Relations      | Henry J. Drive   |
|             | Stream Survey         | Henry J. Drive   |
| 12-13-05    | Stream Cleaning 40'   | Lee Street   |
|             | Stream Cleaning 45'   | Chandler Street  |
|             | Stream Cleaning 50'   | Livingston Street  |
|             | Stream Cleaning 15'   | Whittemore Road  |
|             | Stream Cleaning 20'   | Royal Crest Circle   |
|             | Stream Cleaning 15'   | Royal Crest Circle   |
| 12-13-05    | Stream Cleaning 15'   | Whittemore Road  |
|             | Stream Cleaning 20'   | Royal Crest Circle   |
|             | Stream Cleaning 15'   | Royal Crest Circle   |
|             | Stream Cleaning 15'   | East Street  |
|             | Stream Cleaning 10'   | Carter Street  |
|             | Stream Cleaning 20'   | Quincy Road  |
|             | Stream Cleaning 15'   | Level Lane   |
|             | Stream Cleaning 20'   | Shawsheen Street   |
|             | Stream Cleaning 30'   | Shawsheen Street   |
|             | Stream Cleaning 30'   | Shawsheen Street   |
|             | Stream Cleaning 15'   | Regina S. Drive  |
|             | Stream Cleaning 20'   | Regina S. Drive  |
|             | Culvert Cleaning (28) | Lee Street, Chandler Street, Livingston Street, East Street, Whittemore Road, Royal Crest Circle, Karen Lee Lane, Carter Street, Quincy Road, Shawsheen Street, Level Lane, Bridge Street, South Street, Regina S. Drive   |
| 12-20-05    | Public Relation       | Dirlam Lane, Pringle Street  |
|             | Stream Cleaning 20'   | South Street   |
|             | Stream Cleaning 45'   | Pringle Street   |
|             | Stream Cleaning 40'   | Pringle Street   |
|             | Stream Cleaning 15'   | Pumfret Road   |
|             | Stream Cleaning 65'   | Delwood Road   |
|             | Stream Cleaning 15'   | Chuck's Way  |
|             | Stream Cleaning 20'   | Janet Avenue   |
|             | Stream Cleaning 25'   | Decarolis Drive  |

TOWN OF TEWKSBURY

| <u>DATE</u> | <u>WORK DONE</u>       | <u>LOCATION</u>   |
|-------------|------------------------|---|
|             | Stream Cleaning 10'    | Decarolis Drive   |
|             | Stream Cleaning 15'    | Dirlam Lane   |
|             | Stream Cleaning 10'    | Dirlam Lane   |
|             | Stream Cleaning 15'    | Michigan Road   |
|             | Stream Cleaning 10'    | Michigan Road   |
|             | Stream Cleaning 10'    | Brown Street  |
|             | Stream Cleaning 10'    | Alabama Road  |
|             | Culvert Cleaning (26)  | South Street, Pringle Street, Baldwin Street, Carlton Road, Pringle Street, Pumfret Road, Delwood Road, County Road, Valley Road, Chucks Way, Janet Avenue, Decarolis Drive, Dirlam Lane, South Street, Michigan Road, Brown Street, Alabama Road |
| 12-22-05    | Stream Cleaning 20'    | Kendall Road  |
|             | Stream Cleaning 10'    | Kendall Road  |
|             | Stream Cleaning 20'    | Long Meadow Road  |
|             | Stream Cleaning 30'    | Sandpiper Lane  |
|             | Stream Cleaning 20'    | Trull Road  |
|             | Stream Cleaning 20'    | Trull Road  |
|             | Culvert Cleaning (28)  | North Street, Kendall Road, Fiske Street, Chivas Circle, Maplewood Road, Sheridan Lane, Long Meadow Road, Hood Road, Sandpiper Lane, River Road, Trull Road, Clark Road, Highland View Road, Astle Road   |
| 12-23-05    | Public Relation        | French Street   |
|             | Stream Cleaning 25'    | Astle Street  |
|             | Stream Cleaning 20'    | Astle Street  |
|             | Stream Cleaning 15'    | Main Drive  |
|             | Stream Cleaning 35'    | French Street   |
|             | Stream Cleaning 20'    | French Street   |
|             | Stream Cleaning 15'    | French Street   |
|             | Stream Cleaning 25'    | Whipple Road  |
|             | Stream Cleaning 20'    | Sesame Street   |
|             | Stream Cleaning 15'    | Sesame Street   |
|             | Stream Cleaning 15'    | Whipple Road  |
|             | Culvert Cleaning (15)  | Astle Street, Jodi Drive, Main Drive, French Street, Whipple Road, Sesame Street, Rogers Street   |
| 12-28-05    | Stream Cleaning 30'    | Diane Drive   |
|             | Stream Cleaning 15'    | Helvetia Street   |
|             | Stream Cleaning 30'    | Pleasant Street   |
|             | Stream Cleaning 20'    | Marston Street  |
|             | Culvert Cleaning (28)  | Shawsheen Street, Diane Drive, Foster Road, Colonial Drive, Helvetia Street, Pond Street, Pleasant Street, Whipple Road, Marshall Street, Chapman Road, Marston Street, Windsor Drive, Rodgers Road   |
| 12-30-05    | Administrative Contact | Board of Health   |

2005 Mosquito Surveillance Data  
**TEWKSBURY**

| #  | Town             | Date             | Pool ID          | # Traps | Trap Site      | Pool Size | Species               | Result          | Virus Type |
|----|------------------|------------------|------------------|---------|----------------|-----------|-----------------------|-----------------|------------|
| 1  | Tewksbury        | 6/14/2005        | CM05-00033       | 1       | Marion Dr.     | 41        | <i>Cs. melanura</i>   | Negative        |            |
| 2  | Tewksbury        | 6/20/2005        | CM05NS-00159     | 1       | Marion Dr.     | 27        | <i>Cq. perturbans</i> | N/S             |            |
| 3  | Tewksbury        | 6/27/2005        | CM05NS-00308     | 1       | Marion Dr.     | 1         | <i>Oc. excrucians</i> | N/S             |            |
| 4  | Tewksbury        | 6/27/2005        | CM05NS-00309     | 1       | Marion Dr.     | 79        | <i>Cq. perturbans</i> | N/S             |            |
| 5  | Tewksbury        | 6/27/2005        | CM05NS-00310     | 1       | Marion Dr.     | 1         | <i>An. barberi</i>    | N/S             |            |
| 6  | Tewksbury        | 7/5/2005         | CM05-00167       | 1       | Marion Dr.     | 2         | <i>Cx. species</i>    | Negative        |            |
| 7  | Tewksbury        | 7/5/2005         | CM05-00168       | 1       | Marion Dr.     | 2         | <i>Cs. melanura</i>   | Negative        |            |
| 8  | Tewksbury        | 7/11/2005        | CM05NS-00470     | 1       | Marion Dr.     | 32        | <i>Cq. perturbans</i> | N/S             |            |
| 9  | Tewksbury        | 7/18/2005        | CM05NS-00731     | 1       | Marion Dr.     | 0         | <i>Mixed Species</i>  | N/S             |            |
| 10 | Tewksbury        | 7/18/2005        | CM05NS-00732     | 1       | Marion Dr.     | 0         | <i>Mixed Species</i>  | N/S             |            |
| 11 | Tewksbury        | 7/19/2005        | CM05-00277       | 1       | Marion Dr.     | 2         | <i>Cx. species</i>    | Negative        |            |
| 12 | Tewksbury        | 7/19/2005        | CM05-00278       | 1       | Marion Dr.     | 2         | <i>Cs. melanura</i>   | Negative        |            |
| 13 | Tewksbury        | 7/25/2005        | CM05NS-01003     | 1       | Marion Dr.     | 10        | <i>Cq. perturbans</i> | N/S             |            |
| 14 | Tewksbury        | 8/2/2005         | CM05-00425       | 1       | Marion Dr.     | 2         | <i>Cs. melanura</i>   | Negative        |            |
| 15 | Tewksbury        | 8/2/2005         | CM05-00426       | 1       | Marion Dr.     | 9         | <i>Cx. species</i>    | Negative        |            |
| 16 | Tewksbury        | 8/2/2005         | CM05-00459       | 1       | Marion Dr.     | 5         | <i>Cs. melanura</i>   | Negative        |            |
| 17 | Tewksbury        | 8/2/2005         | CM05-00460       | 1       | Marion Dr.     | 4         | <i>Cs. morsitans</i>  | Negative        |            |
| 18 | Tewksbury        | 8/2/2005         | CM05-00461       | 1       | Marion Dr.     | 14        | <i>Cx. species</i>    | Negative        |            |
| 19 | Tewksbury        | 8/15/2005        | CM05NS-01417     | 2       | Marion Dr.     | 1         | <i>Cq. perturbans</i> | N/S             |            |
| 20 | Tewksbury        | 8/15/2005        | CM05NS-01418     | 2       | Marion Dr.     | 1         | <i>Oc. japonicus</i>  | N/S             |            |
| 21 | Tewksbury        | 8/16/2005        | CM05-00549       | 1       | Marion Dr.     | 6         | <i>Cx. species</i>    | Negative        |            |
| 22 | Tewksbury        | 8/16/2005        | CM05-00550       | 1       | Marion Dr.     | 3         | <i>Cs. melanura</i>   | Negative        |            |
| 23 | Tewksbury        | 8/16/2005        | CM05-00551       | 1       | Marion Dr.     | 7         | <i>Cs. morsitans</i>  | Negative        |            |
| 24 | Tewksbury        | 8/16/2005        | CM05-00552       | 1       | Marion Dr.     | 9         | <i>Cq. perturbans</i> | Negative        |            |
| 25 | Tewksbury        | 8/16/2005        | CM05-00553       | 1       | Marion Dr.     | 5         | <i>Cx. species</i>    | Negative        |            |
| 26 | Tewksbury        | 8/22/2005        | CM05NS-01718     | 1       | Marion Dr.     | 1         | <i>Cq. perturbans</i> | N/S             |            |
| 27 | Tewksbury        | 8/23/2005        | CM05-00666       | 2       | Marion Dr.     | 1         | <i>Cx. species</i>    | Negative        |            |
| 28 | Tewksbury        | 8/23/2005        | CM05-00667       | 2       | Marion Dr.     | 1         | <i>Cs. melanura</i>   | Negative        |            |
| 29 | Tewksbury        | 8/29/2005        | CM05NS-01839     | 1       | Marion Dr.     | 2         | <i>Cq. perturbans</i> | N/S             |            |
| 30 | Tewksbury        | 8/30/2005        | CM05-00730       | 1       | Marion Dr.     | 1         | <i>Cx. species</i>    | Negative        |            |
| 31 | Tewksbury        | 8/30/2005        | CM05-00731       | 1       | Marion Dr.     | 1         | <i>Cs. melanura</i>   | Negative        |            |
| 32 | Tewksbury        | 9/6/2005         | CM05-00842       | 1       | Marion Dr.     | 2         | <i>Cs. melanura</i>   | Negative        |            |
| 33 | Tewksbury        | 9/6/2005         | CM05-00843       | 1       | Marion Dr.     | 2         | <i>Cx. species</i>    | Negative        |            |
| 73 | <b>Tewksbury</b> | <b>9/16/2005</b> | <b>ZL05-0203</b> |         |                |           | <b>Blue Jay</b>       | <b>Positive</b> | <b>WNV</b> |
| 34 | Tewksbury        | 9/19/2005        | CM05NS-02365     | 2       | 85 Walcott St. | 1         | <i>Ae. cinereus</i>   | N/S             |            |

2005 Mosquito Surveillance Data  
**TEWKSBURY**

| #  | Town             | Date             | Pool ID          | # Traps | Trap Site      | Pool Size | Species                       | Result          | Virus Type |
|----|------------------|------------------|------------------|---------|----------------|-----------|-------------------------------|-----------------|------------|
| 35 | Tewksbury        | 9/19/2005        | CM05NS-02366     | 2       | 85 Walcott St. | 6         | <i>Oc. triseriatus</i>        | N/S             |            |
| 36 | Tewksbury        | 9/19/2005        | CM05NS-02367     | 2       | 85 Walcott St. | 2         | <i>Ur. sapphirina</i>         | N/S             |            |
| 37 | Tewksbury        | 9/19/2005        | CM05NS-02368     | 2       | 85 Walcott St. | 3         | <i>An. punctipennis</i>       | N/S             |            |
| 38 | Tewksbury        | 9/19/2005        | CM05NS-02369     | 2       | 85 Walcott St. | 1         | <i>Cq. perturbans</i>         | N/S             |            |
| 39 | Tewksbury        | 9/19/2005        | CM05NS-02370     | 2       | 85 Walcott St. | 1         | <i>Cs. morsitans</i>          | N/S             |            |
| 40 | Tewksbury        | 9/19/2005        | CM05NS-02371     | 2       | Marion Dr.     | 1         | <i>Oc. japonicus</i>          | N/S             |            |
| 41 | Tewksbury        | 9/19/2005        | CM05NS-02372     | 2       | Marion Dr.     | 4         | <i>Oc. triseriatus</i>        | N/S             |            |
| 42 | Tewksbury        | 9/20/2005        | CM05-01040       | 2       | Marion Dr.     | 3         | <i>Cs. melanura</i>           | Negative        |            |
| 43 | Tewksbury        | 9/26/2005        | CM05NS-02397     | 2       | Marion Dr.     | 2         | <i>Oc. japonicus</i>          | N/S             |            |
| 44 | Tewksbury        | 9/26/2005        | CM05NS-02398     | 2       | Marion Dr.     | 1         | <i>Ur. sapphirina</i>         | N/S             |            |
| 45 | Tewksbury        | 9/26/2005        | CM05NS-02400     | 2       | 85 Walcott St. | 1         | <i>Cx. pipiens</i>            | N/S             |            |
| 46 | Tewksbury        | 9/26/2005        | CM05NS-02401     | 2       | 85 Walcott St. | 3         | <i>Cs. melanura</i>           | N/S             |            |
| 47 | Tewksbury        | 9/26/2005        | CM05NS-02402     | 2       | 85 Walcott St. | 2         | <i>Oc. japonicus</i>          | N/S             |            |
| 48 | Tewksbury        | 9/26/2005        | CM05NS-02403     | 2       | 85 Walcott St. | 1         | <i>Oc. triseriatus</i>        | N/S             |            |
| 49 | Tewksbury        | 9/26/2005        | CM05NS-02404     | 2       | 85 Walcott St. | 1         | <i>Cs. morsitans</i>          | N/S             |            |
| 50 | Tewksbury        | 9/26/2005        | CM05NS-02405     | 2       | 85 Walcott St. | 2         | <i>Cx. restuans</i>           | N/S             |            |
| 72 | <b>Tewksbury</b> | <b>9/26/2005</b> | <b>ZL05-0240</b> |         |                |           | <b>American Crow</b>          | <b>Positive</b> | <b>WNV</b> |
| 51 | Tewksbury        | 9/27/2005        | CM05NS-02406     | 2       | Seneca Rd.     | 4         | <i>Oc. triseriatus</i>        | N/S             |            |
| 52 | Tewksbury        | 9/27/2005        | CM05NS-02407     | 2       | Seneca Rd.     | 1         | <i>An. punctipennis</i>       | N/S             |            |
| 53 | Tewksbury        | 9/27/2005        | CM05NS-02408     | 2       | Seneca Rd.     | 6         | <i>Ur. sapphirina</i>         | N/S             |            |
| 54 | Tewksbury        | 9/27/2005        | CM05NS-02409     | 2       | Seneca Rd.     | 1         | <i>Cx. restuans</i>           | N/S             |            |
| 55 | Tewksbury        | 9/27/2005        | CM05NS-02410     | 2       | Navillus Rd.   | 1         | <i>Cs. morsitans</i>          | N/S             |            |
| 56 | Tewksbury        | 9/27/2005        | CM05NS-02411     | 2       | Navillus Rd.   | 4         | <i>Oc. japonicus</i>          | N/S             |            |
| 57 | Tewksbury        | 9/27/2005        | CM05NS-02412     | 2       | Navillus Rd.   | 2         | <i>Oc. triseriatus</i>        | N/S             |            |
| 58 | Tewksbury        | 9/27/2005        | CM05NS-02413     | 2       | Navillus Rd.   | 1         | <i>Ur. sapphirina</i>         | N/S             |            |
| 59 | Tewksbury        | 10/4/2005        | CM05-01149       | 2       | 85 Walcott St. | 5         | <i>Cs. melanura</i>           | Negative        |            |
| 60 | Tewksbury        | 10/4/2005        | CM05-01150       | 2       | 85 Walcott St. | 15        | <i>Ae. vexans</i>             | Negative        |            |
| 61 | Tewksbury        | 10/4/2005        | CM05-01151       | 2       | 85 Walcott St. | 15        | <i>Cx. species</i>            | Negative        |            |
| 62 | Tewksbury        | 10/4/2005        | CM05-01152       | 2       | Marion Dr.     | 1         | <i>Cx. pipiens</i>            | Negative        |            |
| 63 | Tewksbury        | 10/4/2005        | CM05-01181       | 2       | Marion Dr.     | 4         | <i>Cs. melanura</i>           | Negative        |            |
| 64 | Tewksbury        | 10/4/2005        | CM05-01182       | 2       | 85 Walcott St. | 3         | <i>Ae. vexans</i>             | Negative        |            |
| 65 | Tewksbury        | 10/4/2005        | CM05-01183       | 2       | Seneca Rd.     | 2         | <i>An. quadrimaculatus sl</i> | Negative        |            |
| 66 | Tewksbury        | 10/4/2005        | CM05-01184       | 2       | Seneca Rd.     | 28        | <i>Oc. japonicus</i>          | Negative        |            |
| 67 | Tewksbury        | 10/4/2005        | CM05-01185       | 2       | Seneca Rd.     | 7         | <i>Ae. vexans</i>             | Negative        |            |
| 68 | Tewksbury        | 10/4/2005        | CM05-01186       | 2       | Navillus Rd.   | 8         | <i>Ae. vexans</i>             | Negative        |            |

2005 Mosquito Surveillance Data  
**TEWKSBURY**

| #  | Town      | Date                                       | Pool ID    | # Traps | Trap Site    | Pool Size | Species                               | Result   | Virus Type |
|----|-----------|--|------------|---------|--------------|-----------|---------------------------------------|----------|------------|
| 69 | Tewksbury | 10/4/2005                                  | CM05-01187 | 2       | Navillus Rd. | 5         | <i>Cq. perturbans</i>                 | Negative |            |
| 70 | Tewksbury | 10/4/2005                                  | CM05-01188 | 2       | Navillus Rd. | 5         | <i>Cx. species</i>                    | Negative |            |
| 71 | Tewksbury | 10/4/2005                                  | CM05-01189 | 2       | Navillus Rd. | 3         | <i>Cs. melanura</i>                   | Negative |            |
|    |           |  |            |         |              |           |                                       |          |            |
|    |           | <b>35 pools submitted</b>                  |            |         |              |           | <b>424 mosquitoes collected</b>       |          |            |
|    |           |  |            |         |              |           |                                       |          |            |
|    |           | <b>NO VIRUS IDENTIFIED IN 2005</b>         |            |         |              |           | <b>N/S= Not Submitted for testing</b> |          |            |
|    |           |  |            |         |              |           |                                       |          |            |
|    |           | <b>2 BIRDS IDENTIFIED WITH WNV BY MDPH</b> |            |         |              |           |                                       |          |            |



## 2005 SUMMARY

The Central Massachusetts Mosquito Control Project (the Project) currently provides its services to 36 cities and towns throughout Middlesex and Worcester Counties. The Project's headquarters is located at 111 Otis Street, Northboro, MA. Tours of the headquarters or visits to field work sites may be arranged by calling the office in advance. Please call (508) 393-3055 during business hours for more information. The Project practices Integrated Mosquito Management (IMM), blending state of the art methods and techniques with expertise, experience, and scientific research to provide our member communities with environmentally sound and cost effective mosquito control.

During 2005 the Project received seven thousand and eighty five (7,085) requests for service from town residents and officials. A total of over six thousand (6,000) pounds of Bti (*Bacillus thuringiensis israelensis*) was applied by helicopter in 2 towns, Chelmsford & Billerica, and seven thousand, two hundred and ninety nine (7,299) pounds by hand throughout our service area were applied to area wetlands to reduce the emergence of adult mosquitoes. This represents over two thousand and sixty (2,060) acres of wetland that was treated with this mosquito-specific bacterium, significantly reducing adult mosquito populations in these areas. Thirty two thousand, for hundred and forty four (32,444) catch basins were treated with larvicidal product to control the mosquitoes that seek out these cool dark wet areas to breed, including the *Culex* mosquito, a major target for West Nile Virus transmission. Seven thousand, seven hundred and thirty seven (7,737) culverts were cleaned in an attempt to eliminate unnecessary standing water and reduce mosquito breeding. This work was done in conjunction with cleaning, clearing, and digging of one hundred and sixty eight thousand, three hundred and fifty two (168,352) feet of streams, brooks and ditches. This represents almost thirty two (32) miles of waterways which were cleaned and improved by Project personnel in 2005.

The Mosquito Awareness Program which we offer to elementary schools and other civic organizations in our district has become very popular. Project staff meets with students, teachers or concerned residents to discuss mosquito biology, mosquito habitat, and control procedures. Much of the presentation is directed towards what children and their families can do to prevent mosquitoes from breeding around their homes. Slides, videos, coloring books and other handouts make this an interesting program. This program is tailored to meet the needs of the specific audience. One thousand, six hundred and nineteen (1,619) students attended these programs.

As part of our effort to reduce the need for pesticides we continue to expand our wetlands restoration program. By cleaning clogged and overgrown waterways, mosquito breeding can be reduced and drainage areas are restored to historic conditions.

Bti mosquito larvicide is used to treat areas where mosquito larvae are found. We routinely check known breeding sites kept in our database, but also encourage the public to notify us of any areas they suspect could breed mosquitoes. Our field crews will investigate all such requests and treat the area only if surveillance gathered at the time shows an imminent threat of mosquito emergence.

Our goal is to manage all mosquito problems with education, wetlands restoration or larviciding, but we recognize that there are times when adult mosquito spraying is the only viable solution. In such cases specific areas are treated with either hand-held or pickup truck mounted sprayers if surveillance gathered at the time exceeds a pre-determined threshold to warrant an application. This program is offered on a **request-only** basis, and the exclusion process allows residents and/or town officials to exclude areas under their control from this or any part of our program.

The Project's surveillance program monitors adult mosquito and larval population density, and is the backbone for prescribing various control techniques. Specialized mosquito traps are deployed throughout the Project's service area to sample for mosquitoes that may be transmitting mosquito-borne diseases. In conjunction with the Mass. Dept. of Public Health we sample in areas suspected of harboring WNV and other viruses. One thousand, one hundred and fifty three (1,153) pools (collections) of mosquitoes totaling eleven thousand, nine hundred and twenty eight (11,928) specimens were tested for mosquito-borne viruses this year. Two (2) pools of *Cs. melanura* in Westborough were confirmed to be infected with the EEE virus. 6 pools of West Nile Virus were confirmed, 4 in Westborough (3 *Culex* and 1 *Cs. melanura*) and one each in Holliston and Wilmington, both *Culex* species. MDPH identified EEE in Holliston but subsequent surveillance did not confirm any additional virus isolates. No human or horse cases were identified with WNV or EEE in 2005 in our service area.

Educational pamphlets are available to anyone interested in learning about mosquito control and the services provided by the Project, and these items are routinely stocked in member Town/City Halls and libraries. Display boards with information on our program are rotated through area Town Halls throughout the year. We also have a website, [www.cmmcp.org](http://www.cmmcp.org) that has extensive information on mosquito biology, our control procedures, etc. This website has become a model for other Mosquito Projects and has been widely used throughout our service area and beyond.

We would like to thank you for your support during 2005 and we look forward to helping you and your community with its mosquito problems in 2006 and beyond.